Rio Blanco Oil Shale Project

ANNUAL REPORT
TRACT C-a

TERRESTRIAL ECOLOGY - BASELINE STUDIES

WILSON JONES
-SMOOTHIE-
349-49A 129223

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RIO BLANCO OIL SHALE PROJECT

ANNUAL REPORT
TRACT C-a

TERRESTRIAL ECOLOGY - BASELINE STUDIES

Submitted To Area Oil Shale Supervisor,
Geological Survey, U.S. Department of
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Gulf Oil Corporation - Standard Oil Company (Indiana)
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TERRESTRIAL ECOLOGY

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RIO BLANCO OIL SHALE PROJECT

Annual Report

Terrestrial
Baseline Studies

March 1976

This chapter presents the results of the first year (October 1974 - October 1975) of baseline data collection for the Terrestrial Ecological Investigations for RBOSP. Included for each program are objectives, methodology, data summary, and discussion sections.

Results are presented for the following programs: phytosociological, grazing exclosure, range analysis, range production/utilization, small mammals, large mammals, mammalian predators, avifauna, winter track counts, reptiles and amphibians, invertebrates, domestic livestock and threatened and endangered species. A summary of terrestrial ecological interrelationships based on these results is given in Section 7.4.

Data collected during phytosociological, range, small mammal, avifauna, and invertebrate investigations were stored on cassette tapes and analyzed by a Hewlett Packard 9830A programmable calculator. The tables presented in the text for several of these studies were generated on a typewriter interfaced with the HP 9830A. Slight summation errors evident in some of those tables are the result of the HP 9830A carrying all data manipulations to 13 significant figures and rounding off computed values before printing them in tables. Therefore all parameters provided in tables which were derived by summing other values represent the best correct estimate.

All methods of data manipulations not evident from table headings, footnotes or the parameters presented in tables are described in the data analysis methodology section for each investigation. A description of all standard statistical procedures such as determination of means, standard deviation, and regression coefficients are excluded from this section but appropriate references are cited.

7.1 FLORA

A. Phytosociological Studies

1. Objectives - The objectives of vegetation investigations in the vicinity of Tract C-a are to identify the plant species present (floristics), define the structural and compositional organization of these species in recognizable associations (phytosociology), correlate floristics and phytosociology with the biotic and abiotic environment (ecology) and historic usage factors (management), and map the predominant vegetation types.

2. Methods

a. Data Collection - Aerial photographs and pertinent literature were used to identify the major vegetation types on and adjacent to Tract C-a. A vegetation type is recognized by the presence and life form of the dominant overstory plant species. A preliminary selection of sampling locations in each type was made from aerial photographs to assure coverage of the entire area and access along existing roads and trails. Locations having two or more vegetation types in proximity to each other were favored as a means of increasing sampling efficiency. Vegetation sampling locations are indicated in Figure 3-7-1.

Each representative of a type thus selected (such as pinyon-juniper) was then surveyed on the ground and the most prevalent associations (variants) of the overall type (for example, pinyon-juniper with a sagebrush understory) were identified. The largest block of homogeneous vegetation of each association was selected for sampling.

A modification of the line-strip technique as described by Woodin and Lindsey (1954), Lindsey (1955), and Potter (1957) was used during the phytosociological

investigations. This method incorporates attributes of both line-strip and quadrat sampling systems to provide valid and reliable field data for each identified vegetation type. Ninety-six, 60 x 6 m (196.8 x 19.7 ft) transects were sampled in the study area during October of 1974 (Table 3-7-1). The size and number of these transects were considered to be adequate to measure the variability of species composition within each vegetation type over the entire study area. Due to the seasonal senescence of the herbaceous layer during the October 1974 sampling period, many herbaceous plants were only identified to the generic level. At the end of the October 1974 sampling period, the number of vegetation sampling sites was reduced and the size increased because of the limited amount of variability within each type and the limited plant cover.

In 1975, a total of 116, 100 x 6 m (328 x 19.7 ft) transects within the major vegetation types were sampled during three separate sampling periods (May-June, July and September; Table 3-7-2). Thirty-five permanent transects were designated, in which only the herbaceous stratum was sampled again in subsequent sampling periods. These permanent transects provide data on seasonal and annual vegetation changes for the herbaceous stratum. Eighty-one non-permanent transects were used to obtain a better statistical representation of the tree and shrub strata in each vegetation type, both on and off the tract, than would be possible using only permanent transects. The herbaceous stratum of the non-permanent transects was not sampled except in those vegetation types (riparian, bald) where sampling the herbaceous stratum was necessary for adequate characterization of the site.

1) Location and Orientation of Sampling Transects - When a representative area to be sampled was large, a randomization process was utilized to locate the starting point and orientation of transects. Where the size or topographic position of the area to be sampled prohibited execution of the randomization procedure (as in riparian, greasewood or bottomland sagebrush types), oreintation of the transects was subjectively determined so that a representative sample was obtained. In this procedure only the location of the starting point was randomized.

2) Data Gathering and Recording - Quantitative and qualitative phytosociological data were gathered for tree, shrub, and herbaceous strata in each permanent transect, and for tree and shrub strata in the non-permanent transects. The herbaceous stratum was sampled on non-permanent transects only when herbaceous stratum data were considered necessary for adequate characterization of a site.

a) Tree and Shrub Strata - A taut 30 m (98.4 ft) tape defining the centerline of the transect was used to determine the foliage intercept distance along the line for each of the 100 m transects. The first and last numerical units of the tape which were vertically intercepted by foliage of each tree or shrub along the line were recorded in the I_1 and I_2 columns of the data sheets shown in Figures 3-7-2, 3-7-3 and 3-7-4. The difference between the first and last numerical units of the tape gave the total units of foliage cover by an individual plant. A new data sheet was started for each new transect. Species were listed as they were encountered. Enough space was left between entries to allow recording of intercept data in the I_1 and I_2 columns. When the space between entries was filled with intercept data, a new data sheet was begun.

In addition to foliage intercept distances, counts of shrubs, seedlings, and saplings of each species occurring within approximately 3 m (9.84 ft) on either side of the tape measure were also recorded. The 3 m distance from the tape was measured with a meter stick at the start of each transect and was repeatedly measured when distances of individual shrubs or trees were in doubt. Density values for shrubs, and for seedlings and saplings of tree species were determined from this census. Census data were collected and recorded by 20 m (65.6 ft) segments of the transect, effectively making a series of 5 quadrats, approximately 20 m x 6 m. This series of quadrats served as the basis for calculations of frequency values for the shrub and tree strata.

The volumes of all shrub species were calculated for the May-June sampling period. Volume estimates for each intercepted shrub were calculated by mentally averaging the length, width, and height of the observed plant to produce the diameter of a visualized hypothetical sphere. The volume for each sphere

was then calculated and all volumes were summed to produce a total volume for each species within a type. An average (mean) volume was computed for each species within a type. An average (mean) volume was computed for each species by dividing its total volume by its number of diameters. Volume (m^3) per hectare was obtained by multiplying the average (mean) volume of a species by its density per hectare.

The diameters of mature trees located in each quadrat were recorded in centimeters. A tree was considered to be mature if its trunk diameter was greater than 7.6 cm (3 in.). Recorded diameters were then used in determinations of density for members of the mature tree class. Size-class distributions were also derived from the recorded measurements of trunk diameters. Trunk diameters were estimated to the nearest centimeter with a meter stick. For pinyon and juniper trees, measurements were made just below fork swell and above basal fluting at the 0.5 m (1.64 ft) level (Barger and Ffolliott, 1972) because of their low branching habit. The straight-boled Douglas-fir and aspen trees were measured at the customary breast height of 1.37 m (4.5 ft).

b) Herbaceous Stratum - Herbaceous cover values were estimated within a 0.5 m (1.64 ft) by 1 m (3.28 ft) rectangular metal frame quadrat. The long axis of the quadrat was placed parallel to and on the right side of the centerline tape and centered at 10 m intervals. Each species was identified and listed (Figure 3-7-5). Plants not identifiable to the species level were collected and assigned a code number corresponding to the entry on the data sheet. The ground cover of each species was estimated to the nearest 1%. When it was estimated that the total cover or a species cover value was less than 1% (e.g., one blade of grass), it was recorded as a trace. Frequency values were derived from the recorded occurrence of each species in the ten, 0.5 m x 1 m quadrats sampled along each transect. Forb density (number of individuals of a species occurring in each quadrat) was recorded. Density of grasses or grass-like species was not determined.

c) <u>Phenology</u> - A phenology code was used for all flowering plants (Angiospermae) to indicate the stage of development for each species observed in a given sampling period. Stages were labelled as follows: emergent,

vegetative, initiation of flowering, flowers fully developed, initiation of fruits, fruits fully developed, seasonal senescence, death or dormancy of plant.

3) Plant Collection - Plant specimens were collected to serve two objectives. The first was to obtain a voucher collection of all species encountered in the study area. The second was to collect for laboratory identification any plant not identified to the species level in the field.

Plant specimens collected during each vegetation sampling period were field identified, tagged, coded for location, and placed in plastic bags. The identification, location code, number, date of collection, and collector of each specimen were recorded in a field log book every day. All plant specimens were then routed to the laboratory where identifications to the species level were made or verified. Harrington (1954) was used as the basic authority on plant identification; Weber (1972a), Hitchcock (1971), and Hermann (1970) were used to obtain more recent treatments of taxonomically difficult plant groups. Weber (1972b) was utilized as the source of the most up-to-date nomenclature available. Plummer et al. (1966) was used as the source of common names.

b. Data Analysis - The following species parameters were estimated from phytosociological data collected for mature tree, shrub-tree seedling, and herbaceous strata sampled on permanent and/or non-permanent transects:

- % cover - average % canopy cover of a species.
- Cover (m^2 per unit area) - an estimate of the number of square meters per a specified area (e.g., hectare) covered by the canopy of a species.
- Shrub volume - volume of visualized, hypothetical sphere enclosing the shrub canopy.
- Frequency (%) - the % of sampling units within a transect that include a species.
- Constancy - the % of transects within a type that include a species.
- Density - number of individuals of a species per unit area (e.g., #/ha) expressed as average #/quadrat for herbaceous species.
- Basal area (m^2 per unit area) - an estimate of the area in square meters of the trunks of a tree species per a specified unit area (e.g., hectare). The area of a trunk is determined from the formula $\pi d^2/4$, when d is the trunk diameter at a specified point.

- Sociability - density (#/quadrats) divided by the frequency. An index to the pattern of herbaceous species distribution.

The formulae used to provide estimates of the above parameters are listed below for the mature tree, shrub-tree seedling and herbaceous stratum. Definitions of parameters used in the formulae are provided.

1) <u>Parameters Used in Formulae</u>

- I_i = total intercept length, species i, each transect.
- SI_i = total intercept length, species i, all transects, each vegetation type.
- I_t = total intercept length, all species, each transect.
- SI_t = total intercept length, all species, all transects, each vegetation type.
- T_l = transect length.
- T_w = transect width.
- a = # of transects, each type.
- N_i = number of individuals, species i, each transect.
- SN_i = number of individuals, species i, all transects, each vegetation type.
- N_t = number of individuals, all species, in a transect.
- SN_t = number of individuals, all species, all transects, each type.
- Q_i = number of quadrats in which species i occurs for a transect.
- SQ_i = number of quadrats in which species i occurs for all transects within a type.
- Q_t = number of quadrats in which all species occur in a transect.
- SQ_t = number of quadrats in which all species occur in all transects, each type.
- b = number of quadrats within a transect.
- C_i = number of transects of a type in which species i occur.
- d_i = trunk diameter for a mature tree i.
- r_i = radius of a hypothetical sphere enclosing the volume of a shrub, species i.

- basal area = $\pi d^2/4$.
- BA_i = total basal area for species i, each transect.
- SBA_i = total basal area for species i, all transects, each vegetation transect type.
- BA_t = total basal area for all species, each transect.
- SBA_t = total basal area for all species, all transects, each vegetation type.

2) <u>Formulae</u>

- % cover (each transect) = $\frac{I_i}{I_t} \times 100$
- % cover (each type) = $\frac{SI_i}{SI_t} \times 100$
- cover - m^2/ha (each transect) = $\frac{I_i}{T_1} \times 10{,}000\ m^2$
- cover - m^2/ha (each type) = $\frac{SI_i}{ST_1} \times 10{,}000\ m^2$
- relative cover (each transect) = $\frac{I_i}{I_t} \times 100$
- relative cover (each type) = $\frac{SI_i}{SI_t} \times 100$
- density (transect) = N_i
- density (type) = SN_i
- density (#/quadrat) = N_i/b
- absolute density - ind/ha (transect) = $\frac{N_i \times 10{,}000}{T_1 \times T_w}$
- absolute density - ind/ha (type) = $\frac{SN_i \times 10{,}000}{T_1 \times T_w \times a}$
- relative density (transect) = $\frac{N_i}{N_t} \times 100$

- relative density (type) = $\frac{\Sigma N_i}{\Sigma N_t} \times 100$
- frequency - % (transect) = $\frac{Q_i}{b} \times 100$
- frequency - % (type) = $\frac{SQ_i}{ab} \times 100$
- relative frequency (transect) = $\frac{Q_i}{Q_t} \times 100$
- relative frequency (type) = $\frac{SQ_i}{SQ_t} \times 100$
- constancy = $\frac{C_i}{a}$
- basal area - m^2/ha (transect) = $\frac{BA_i \times 10{,}000\ m^2}{T_l \times T_w}$
- basal area - m^2/ha (type) = $\frac{SBA_i \times 10{,}000}{a \times T_l \times T_w}$
- mean shrub volume (transect) = $\frac{\Sigma 4/3\ \pi r_i^3}{N_i}$
- mean shrub volume (type) = $\frac{\Sigma 4/3\ \pi r_i^3}{SN_i}$
- sociability (herbaceous species only) = $\frac{\text{density (\#/quadrat)}}{\text{frequency}}$

3. Data Summary

a. Data Organization and Content

1) Data Synthesis - Field data were summarized for October 1974 and all 1975 sampling periods. October 1974 data were presented separately because of changes in sampling methodology between 1974 and 1975 (conversion from 60 to 100 meter long transects). To maintain continuity of data presentation, only 1975 data are discussed in the results and discussion sections. Data were combined for the three 1975 sampling periods for the mature tree and shrub strata to present a regional average for each major vegetation type. The herbaceous

stratum data for all sampling periods were presented separately to present major compositional and structural changes over the growing season for the major vegetation types.

The three predominant vegetation types on the study area (sagebrush, mixed brush, and pinyon juniper) were further divided into their major variants, or associations. All shrub and tree data collected during 1975 were synthesized to describe these associations. Herbaceous data for July only were presented to describe the herbaceous stratum at the height of its development for each association.

2) Sampling Coverage, Structural and Compositional Diversity - The extent of sampling in each vegetation type was summarized by presenting the number of permanent and non-permanent transects, total number of herbaceous quadrats sampled within a vegetation type, and the number of quadrats that were treated as permanent. Due to changes in the location of permanent transects established in 1974, all 1974 transects were treated as non-permanent. Changes in location were made to improve the distribution of sampling points. Total structural and compositional diversity were enumerated by presenting the number of strata (tree, shrub, herbaceous) present, and the number of species encountered in each stratum.

3) Table Organization - The tables are organized by vegetation type, life form categories (tree, shrub, herbaceous) within each type, and by sampling period. The appropriate association tables are organized by life form after each vegetation type. This system permits rapid comparisons among sampling periods, among the different strata within a type, and among plant associations.

The species order in the tables was determined by species cover values and are ranked from highest to lowest. If cover values were the same for two species, then their arrangement in the tables was determined by frequency values from highest to lowest. If cover and frequency values were the same, arrangement was determined by density values from highest to lowest. If the above three values

were the same, or if density values were not available, the arrangement was determined by alphabetical order.

A written synopsis of each vegetation type and association accompanies the tabular presentation. It directs attention to the more important structural and compositional concepts as they relate to the functional and descriptive characterization of each vegetation or association type. Included in this characterization are observations on elevation, degree of slope, slope aspect, soils and gradient relationships for each vegetation type or association analyzed.

4) Topographic Characteristics - The elevational range and average elevation for each vegetation type and association were summarized from the 1974 and 1975 transect data (Figure 3-7-6). Average slope inclination in degrees, and the percentage of transects occurring in each slope aspect quadrant were summarized for each type and association. Slope aspect quadrants were defined as follows: north = 315° - 44°; east = 45° - 134°; south = 135° - 224°; west = 225° - 314°.

5) Soils - The location of vegetation transects was correlated with a recent Soil Conservation Service soils map (1975) covering all of Tract C-a and the surrounding area within one mile of Tract C-a. Percentages of 1975 transects occurring on each identified soil series within the mapped area were summarized for each type.

6) Type Presentation - Parameters for the mature tree stratum presented in type tables and discussed in the results synopsis include: phenology of each species at each sampling period in each type (not recorded for gymnosperms), percent cover, percent frequency, constancy, cover in m^2 per hectare, density per hectare, basal area in m^2 per hectare, and size-class data for trees.

Parameters for the shrub-tree seedling stratum presented in type tables and discussed in the text include: phenology of each species at each sampling period in each type (not recorded for gymnosperms), percent cover, percent

frequency, constancy, cover in m^2 per hectare (not discussed directly because of derivation from percent cover), density in individuals per hectare, mean volume, and mean volume per hectare (volume measurements taken in May-June, 1975 on permanent transects).

Importance values, presented in previous reports, were deleted because the parameters from which importance values were derived (percent cover, percent frequency, and density) are expressed in full in the tables. The full presentation of these parameters permits an independent assessment of the relative influence of these parameters on species importance without the development of an importance value (Daubenmire, 1968).

Mean intercept values, presented in previous reports, were deleted because they do not necessarily reflect the size of an individual shrub since several individuals may contribute cover to a single intercept, and because mean intercept values give no indication of height. Individual shrub volume measurements provide a three dimensional concept of the shrub species encountered.

Other relationships discussed in the text include total species diversity, total cover and density, relative cover and density of dominant species, other common species over the type based on constancy values, phenology of dominants, enumeration of number of species observed in each phenological stage, and any anomalies or other major relationships apparent from the data.

Parameters for the herbaceous stratum presented in vegetation type tables and discussed in the text include: phenology of all species in each type, percent cover, percent frequency, constancy, cover in m^2 per hectare (not discussed directly because of derivation from percent cover), density of forb species in number of individuals per quadrat (.5 m^2), and sociability for forb species. Additional relationships discussed in the text include: total species diversity and total cover, relative cover of dominant species within the type, other common species in the type based on constancy values, degree of stability in species composition (expressed as the percentage of species found in common between two sampling periods), and enumeration of all species encountered in each phenological stage (one species may be included in several stages).

7) Association Presentation - A restricted number of parameters was discussed for the associations identified within the mixed brush, pinyon-juniper, and sagebrush vegetation types. Extent of sampling, total structural and compositional diversity, and summary of topographic characteristics were presented in the same format as was used to describe the major vegetation types. Comparisons of the elevational average and the average slope inclination were made between the association and the type.

Parameters discussed for the mature tree stratum include: percent cover, frequency, density per hectare, constancy, and basal area. The above values were compared to the averages for these parameters.

Shrub-tree seedling stratum parameters discussed include percent cover, frequency, and density per hectare. Other relationships discussed include: distinguishing structural and compositional criteria for the association; relative cover, density, and frequency of dominants; other common species based on frequency values; and comparison of all tabular values to vegetation type averages.

Herbaceous stratum parameters include percent cover, frequency, and density for forb species for the ten herbaceous species with the highest cover in the association, total number of species recorded for the association, and total cover for the association for that sampling period.

8) Ordination - The distribution of vegetation may be largely explained by the interaction of morphological and physiological characteristics of a plant species with abiotic factors (light, temperature, water, and soil) and biotic factors (competitive and pathological interactions with other members of the plant community and consumption by herbivores). These factors act to define a range of environmental conditions within which a plant species may expand its population, maintain a stable population, or die out.

Ordination of transects along elevational and topographic gradients is a method to determine whether there are apparent large scale patterns of plant structure and composition which may be best explained by certain combinations of abiotic factors (Whittaker, 1967).

For each transect in each of the types analyzed, data were assembled for elevation, degree of slope, slope aspect, total shrub cover and density, herbaceous cover (where applicable), total tree cover and density, and tree basal area. Total tree and shrub cover were plotted against elevation for all transects for each type.

Underlying assumptions about the relative effects of certain environmental factors, and of indices of plant response to these factors, are as follows:

- An increase in elevation is correlated with an increase in annual precipitation and cooler growing season temperatures, resulting in greater available moisture.
- South exposures are warmer, and evapo-transpiration rates are higher than on north exposures. In analysis of slope effects in the study area, north is defined as a range from 315° through north to 135°; south is defined as a range from 135° through south to 315°; when all aspects are considered, north = 315° - 44°, east = 45° - 134°, south = 135° - 224°, west = 225° - 314°.
- An increase in slope inclination toward the vertical results in a relative increase in the temperature and evapo-transpiration rate on south exposures. An increase in slope on north exposures is assumed to lower the temperature and reduce the evapo-transpiration rate. For the purposes of this study, slopes of less than 5° are assumed to have little effect on temperature and evapo-transpiration rates, and slopes in excess of 5° are assumed to have some effect on temperature and evapo-transpiration.
- No wind data were examined for the study area, but it appears that wind has a significant effect in increasing evapo-transpiration rates, particularly in the vicinity of the summit of Cathedral Bluffs.
- The effects of soil depth, texture, and chemical properties are considered as contributing factors to the distribution of plant communities.
- The percent cover for a given species or group of species is the best index for the relative success of a species or group of species on a given site, and is a measure of the influence of one species or a

group of species on other members of the plant community. The stratum (tree, shrub, herbaceous) is the basic unit of comparison in this analysis, although the effects of particular species are cited when appropriate. A secondary consideration is the effect of density as it relates to age and size. In general, it is assumed that for the shrub stratum an increase in cover is directly related to an increase in density. For the tree stratum, density is not considered a function of cover, since older trees may contribute a high percent cover, but occur at low densities.

b. Floristics - The flora identified in the study area during 1974-1975 includes 5 tree species, 36 shrub species, 169 forb species and 46 grass and/or grasslike species. A list has been compiled arranging all species in four life form categories (tree, shrub, herbaceous non-grasslike, and grass and grasslike). The species are listed in alphabetical order with the appropriate author citation, family, life form and common name (Table 3-7-3). Whether the species is introduced or native and whether a voucher specimen has been collected is also indicated.

One endangered species, Astragalus lutosus (Smithsonian Institution, 1975), one endemic species, Aquilegia barnebyi (Munz, 1949), and the Colorado state flower, Aquilegia caerulea (Harrington, 1964), occur in the study area. Eleven exotic forb species and 5 exotic grass species, introduced from outside the North American continent, were found in the study area.

The ecological amplitude of a species is the range of habitat variation that a species can endure. Table 3-7-4 illustrates the ecological amplitude (or range of adaptability) of species sampled within the study area. This range is indicated by presence or absence and cover of a species within each plant community sampled in the study area. The species are arranged by life form into tree, shrub and herbaceous categories in alphabetical order by the abbreviation shown in the species list. The percent cover of each species is listed for each type or association where the species occurred.

c. Data Presentation

1) Aspen - The aspen type was sampled with two permanent and three non-permanent transects. Shrub and tree strata were measured on all transects. A total of sixty 0.5 m^2 quadrats were used to sample the herbaceous stratum. Twenty of these quadrats were sampled three times on the two permanent transects. Three strata and 55 species were identified for the aspen type: two species in the mature tree stratum, 14 species in the shrub stratum, and 41 species in the herbaceous stratum. Populus tremuloides and Pseudotsuga menziesii occurred in both the tree and shrub strata.

The aspen type was sampled over an elevational range of 8,140 feet to 8,560 feet, with an average elevation of 8,410 feet for the transects sampled (Figure 3-7-6). Seventy-eight percent of the transects occurred on north-facing slopes and 22% on east-facing slopes. The average degree of slope for all transects was 14°.

The aspen vegetation type is found on deep, loamy soils which are high in organic matter. No detailed soils information was available for this type within the study area.

The mature tree stratum (Table 3-7-5) contributed a total cover of 42%. It was dominated by Populus tremuloides with a cover of 41%, a basal area of 21 m^2 per hectare, and a density in individuals per hectare of 623. Pseudotsuga menziesii was only found in 8% of the tree and shrub quadrats.

Seventy-five percent of Populus tremuloides individuals occurred in the shrub-tree seedling class, 0-7.6 cm (Table 3-7-6). In the mature tree class the largest percentage of individuals was in the 7.6-24 cm size class and less than 1% was found in size classes above 40 cm.

Populus tremuloides was observed only in the vegetative state during all sampling periods.

Fourteen species provided 70% total cover, and a total density of 15,672 individuals per hectare for the shrub-tree seedling stratum (Table 3-7-7).

Amelanchier alnifolia, Amelanchier utahensis, and Prunus virginiana were the dominant species, contributing 64% relative cover, 20% relative density, and occurring at constancies of 100%. Other highly constant species were Rosa woodsii and Prunus virginiana. Mean shrub volume for Amelanchier alnifolia was 22 m^3; Prunus virginiana was estimated at 3 m^3. Phenology for the three dominant species in 1975 was identical: leafing out or vegetative in May-June, forming fruits in July, and existing in a vegetative state in September. Of the 11 species encountered in May-June, 9 were leafing out, and 9 were in a vegetative state. Of the 9 species encountered during July, 1 was in a vegetative state, 3 species were flowering, and 5 were forming fruits. Of the 9 species encountered in September, 9 were in a vegetative state, and 2 were disseminating seeds.

Fourteen species and one unknown contributed 4% total herbaceous stratum cover during May-June, 1975 (Table 3-7-8). A sedge, Carex geyeri, was the dominant species over the type, providing 73% relative cover, and occurring at a constancy of 100%. Of the 14 species identified, 13 species were in a vegetative state, and 1 was forming flowers.

Twenty-five species contributed 42% cover in the quadrats sampled during July. Dominance was shared by Viola rugalosa, Thermopsis montana, and Osmorhiza depauperata, together contributing a relative cover of 41%, and occurring at constancies of 50, 100, and 50%, respectively. Other highly constant species were Carex geyeri, Galium boreale and Solidago sp.. Maximum forb density was provided by Galium boreale, six individuals per 0.5 m^2. Forty percent of the species found in May-June were found again in July. Sociability values were high for several species indicating a clumped distribution of these species. Of the 25 species encountered in July, 20 were in a vegetative state, 5 were forming flowers, 5 were flowering, and 4 were forming seeds.

Twenty-two species contributed 26% cover in the quadrats sampled during September. Carex geyeri was the dominant species, contributing a relative cover of 25%, and occurring at a constancy of 100%. Other highly constant species were Thermopsis montana, Bromus marginatus, and Valeriana occidentalis. Eighty-six percent of the species found during September were also found in

July. Maximum forb density was contributed by Galium boreale, with 5.1 individuals per 0.5 m^2. Sociability values remained high, in concordance with the May-June results. Of the 22 species encountered during September, 16 were in a vegetative state, 7 were disseminating seeds, and 2 were emergent.

2) Douglas-Fir - The Douglas-fir type was sampled with two permanent and nine none-permanent transects. Shrub and tree strata were measured when present on all transects. A total of sixty 0.5 m^2 quadrat locations was used to sample the herbaceous stratum. Twenty of these quadrats were sampled three times on the two permanent transects. Three strata and 49 species were identified for the Douglas-fir type: 2 species in the mature tree stratum, 19 species in the shrub stratum, and 31 species in the herbaceous stratum. Pseudotsuga menziesii and Populus tremuloides occurred in both the tree and shrub strata.

The Douglas-fir type was sampled over an elevational range of 7,800 feet to 8,500 feet, with an average elevation of 8,330 feet for the transects sampled (Figure 3-7-6). Eighty-two percent of the transects occurred on north-facing slopes, 9% on east-facing slopes, and 9% on west-facing slopes. The average degree of slope for all transects was 14°.

No detailed descriptions for soils occurring under the Douglas-fir type on the study area were available. Field observations indicate that soils are shallow and occur on steep slopes.

In the mature tree stratum (Table 3-7-9) two species contributed a total cover of 54% in 1975, occurring at a density of 470 individuals per hectare. Pseudotsuga menziesii was the dominant species encountered during all sampling periods, providing 99% relative cover. A density of 467 individuals per hectare was estimated. Populus tremuloides was unimportant in this type, providing less than 1% cover, and 3 individuals per hectare. Total basal area for Pseudotsuga menziesii was 31 m^2 per hectare.

Diameters of Pseudotsuga menziesii individuals in the mature class ranged from 7.6 cm to 72 cm dbh, with 30% of the trees greater than 24 cm dbh (Table 3-7-6).

When mature and tree seedling-sapling strata were combined, 67% of all Douglas-fir individuals were classified as seedlings or saplings (less than 7.6 cm dbh), indicating substantial reproduction in the stands sampled, and also high seedling-sapling mortality.

In the shrub-tree seedling stratum (Table 3-7-10), eighteen species provided 56% total cover, and total density of 12,227 individuals per hectare. Amelanchier utahensis and Symphoricarpos oreophilus shared dominance providing 42% relative cover, 46% relative density, and occurring at a constancy of 80 and 100%, respectively. Mean volumes for the dominant species were 468 m^3 for Amelanchier utahensis and less than 1 m^3 for Symphoricarpos oreophilus. Phenology of the dominants ranged from leafing out in May and June, flowering for Symphoricarpos oreophilus and fruit development for Amelanchier utahensis in July, and a return to a vegetative state in September for both species. Of the eight species encountered in May-June, six were leafing out and three were vegetative. Of the 11 species encountered in July, one was forming flowers, four were flowering, and six were forming seeds. Of the ten species encountered during September, ten were in a vegetative state and three were declining. Other common species included Prunus virginiana, Pseudotsuga menziesii, and Rosa woodsii.

In the herbaceous stratum (Table 3-7-11), 9 species contributed 9% total cover in the May-June quadrats. The dominant species was a sedge, Carex geyeri, contributing a relative cover of 83%, and occurring at a constancy of 100. Another highly constant species was Mahonia repens. Of the nine species eight were in a vegetative state, and one was emerging from the soil.

During July, 23 species, consisting primarily of perennial forbs, contributed a total cover of 23%. The dominant species was Carex geyeri, with a relative cover of 46%, and constancy of 100%. Other highly constant (100%) species included Thalictrum fendleri, Galium boreale, and Achillea lanulosa. Seventy-eight percent of the species encountered in June were again encountered in July. Maximum density was provided by Thalictrum fendleri, three individuals per 0.5 m^2. Sociability values were high for Thalictrum fendleri, Solidago sp., and Chenopodium fremontii, indicating a clumped distribution was forming

flower buds for these species. Of the 23 species encountered, 16 were in a vegetative state, 2 were flowering, 2 were forming fruits, 1 was disseminating seeds, and 1 was declining.

During September, 18 species contributed a total cover of 15%. Carex geyeri was the dominant species, with a relative cover of 66%, and a constancy of 100%. Other species with a 100% constancy were the same as those sampled in July. Eighty-three percent of the species encountered in September were also found in July. Maximum forb density was provided by Thalictrum fendleri, 2.0 individuals per 0.5 m^2. Sociability values were low for all species, indicating a generally dispersed distribution. Of the 18 species encountered, 15 were in a vegetative state, and 3 were declining or dead.

3) Mixed Brush - The mixed brush type was sampled with five permanent and 25 non-permanent transects. Shrub and tree strata were measured on all transects when present. A total of 180 0.5 m^2 quadrat locations was used to sample the herbaceous stratum. Fifty of these quadrat locations were sampled three times on the five permanent transects. Three strata and 91 species were identified for the mixed brush type: one species in the mature tree stratum, 20 species in the shrub stratum, and 71 species in the herbaceous stratum. Pinus edulis occurred in both the tree and shrub strata.

The mixed brush type was sampled over an elevational range of 7,150 feet to 8,600 feet, with an average elevation of 8,093 feet for the transects sampled (Figure 3-7-6). Forty-three percent of the transects occurred on east-facing slopes, 23% on north-facing slopes, 17% on south-facing slopes, and 17% on west-facing slopes. The average degree of slope for all transects was 11°.

Of ten transects occurring within the mapped area, 60% occurred on the Rentsac soil series which are shallow, well-drained soils formed from sandstone. These soils occur on 5 to 50% slopes. Forty percent of the transects occurred on a combination of the Rentsac and Piceance soil series. The Piceance soil series consists of moderately deep, well-drained soils that formed from sandstone and modified windblown material. These soils are on upland slopes and ridges with 5 to 15% slopes.

In the mature tree stratum (Table 3-7-12), one species, Pinus edulis, provided 0.1% cover, a basal area of 0.03 m^2 per hectare, and occurred at a density of two individuals per hectare. Pinus edulis occurred at a constancy of 8%.

In the shrub-tree seedling stratum (Table 3-7-13), 20 species provided 58% cover, and occurred at a density of 13,116 individuals per hectare. Amelanchier utahensis was the dominant species providing a relative cover of 52%, and occurring at a density of 2,902 per hectare. Mean volume for Amelanchier utahensis was 236 m^3, representing large patches of this species. Phenology for the dominant species (Amelanchier utahensis) ranged from vegetative to full bloom during May-June, ripening fruit during July, declining to a vegetative state in September. Of the 11 species sampled in May-June, all 11 were found in an emergent or vegetative state, 3 species were forming buds, and 1 was in bloom. Of the 12 species sampled during July, 2 were vegetative, 5 were forming flower buds or flowering, and 6 were developing fruits or seeds. Of the 10 species sampled in September, 6 were in a vegetative state, 2 were forming seeds, and 3 were disseminating seeds.

Highest constancy (100%) was shared by Amelanchier utahensis and Symphoricarpos oreophilus in 1975. Other common associates include Chrysothamnus viscidiflorus and Artemisia tridentata.

In the herbaceous stratum (Table 3-7-14), 44 species contributed 5% cover during May-June. Carex geyeri was the dominant species, providing relative cover of 40%, and occurring at a constancy of 60%. Other highly constant species were Oryzopsis hymenoides, Penstemon caespitosus, and Agropyron trachycaulum. The dominant species, Carex geyeri, was found in both a vegetative and a flowering condition. Of the 44 species encountered during this sampling period, 35 were in a vegetative condition, and 16 were forming flower buds, or were flowering.

Forty-six species contributed 11% total cover during July. A sedge, Carex geyeri, a perennial forb, Eriogonum umbellatum, and a grass, Oryzopsis hymenoides, shared dominance, providing a relative cover of 40%. These species occurred at constancies of 40, 60, and 80%, respectively. Another highly constant species was Cryptantha sericea. Seventy-six percent of the

species found during May-June were found again in July. Maximum density was provided by Eriogonum umbellatum, 1.3 individuals per 0.5 m^2. Sociability values were low for all forb species, reflecting the low density and low frequency of individuals of this group. Of the 46 species recorded for July, 29 were in a vegetative state, 6 were flowering, 7 were forming seeds, 14 were disseminating seeds, and 8 were declining.

During September, 34 species contributed 8% cover. The sedge Carex geyeri was again the dominant species, providing a relative cover of 35%, and occurring at a constancy of 60%. Eighty-two percent of the species found in September were also found during July. Senecio canus contributed maximum forb density, 1.1 individuals per 0.5 m^2. Sociability values were low for all forb species, indicating a dispersed distribution. Of the 34 species encountered in September, 23 were in a vegetative state, 2 were forming flower buds or flowering, 5 declining, and 7 dead or dormant.

a) Associations - The mixed brush type is represented by two major variants or associations on the study area, the Utah serviceberry (Amelanchier utahensis)-Gambel oak (Quercus gambelii)-snowberry (Symphoricarpos oreophilus)-elk sedge (Carex geyeri) mixed brush association, and the Utah serviceberry (Amelanchier utahensis)-snowberry (Symphoricarpos oreophilus) mixed brush association. Transects sampled for the mixed brush type were divided into these two associations on the basis of structural and compositional criteria. Tree and shrub strata data were synthesized for the two associations. Herbaceous data for July were presented to define the maximum herbaceous development for the season.

Utah serviceberry (Amelanchier utahensis)-Gambel oak (Quercus gambelii) association is represented by seven transects. The herbaceous stratum was measured with seventy 0.5 m^2 quadrat locations, of which 20 were sampled three times during 1975. Two strata and 36 species were identified in Utah serviceberry-Gambel oak association: 13 species in the shrub stratum, and 23 species in the herbaceous stratum (includes the July sampling period only).

The Utah serviceberry-Gambel oak association occupied an elevational range of 7,150 feet to 8,500 feet, with an average elevation of 8,080 feet for the

transects sampled (Figure 3-7-6). Seventy-two percent of the transects occurred on east-facing slopes, 14% on north-facing slopes, and 14% on south-facing slopes. Average slope inclination for all transects was 18°. The elevational average for this association is nearly the same as the type average (8080 vs. 8090 feet), but the association occurs on steeper slopes than the type average (18° vs. 11°).

Transects sampled in this association occurred primarily on Rentsac soils. No mature trees were sampled in this association. Young aspen trees appeared in the shrub stratum on some transects, indicating a continuity of this association with the shrub understory of the aspen type on the study area.

The major characteristics of this association are the high (80%) cover and density (15,473 individuals per hectare) of the shrub stratum (Table 3-7-15). The three dominant species, Amelanchier utahensis, Symphoricarpos oreophilus, and Quercus gambelii, together provided a relative cover of 80% and relative density of 56%. Cover values for this association are higher than those for the type as a whole (80% for the association vs. 40-60% for the mixed brush vegetation type), and density values are generally higher or equal to the type as a whole (15,473 vs. 13,116 and 16,829 per hectare). The presence of species common in wetter aspen and douglas-fir types (Prunus virginiana, Rosa woodsii, Ribes inerme) and also in the drier sagebrush-mixed brush types (Artemisia tridentata, Chrysothamnus viscidiflorus, Tetradymia canescens) indicates the strongly transitional nature of this association.

During the July 1975 sampling period, 23 species contributed 26% total herbaceous stratum cover (Table 3-7-16). The dominant species was a sedge, Carex geyeri, which provided a relative cover of 24%. The dominance of this species is consistent with its overall dominance within the type. Carex geyeri is strongly associated with vegetation communities with high deciduous shrub and tree cover, and with higher altitude (7,500-8,500 ft) coniferous forest (Table 3-7-4) in the study area. Comandra umbellata had the highest density, 2.8 individuals per .5 m^2.

The serviceberry (Amelanchier utahensis)-snowberry (Symphoricarpos oreophilus) association is represented by 23 transects of which 11 were summarized for 1975.

The herbaceous stratum was measured with a total of 150 quadrat locations, of which 30 were sampled 3 times during 1975. Three strata and 44 species were identified for this association: 1 species in the tree stratum, 15 species in the shrub stratum, and 29 species in the herbaceous stratum. Pinus edulis occurred in both the tree and the shrub strata.

The Utah serviceberry-snowberry association occupied an elevational range of 7,140 ft to 8,480 ft, with an average elevation of 7,760 ft. Forty-five percent of all transects were on north-facing slopes, 23% on east slopes, 18% on south slopes, and 14% on west slopes. Average slope inclination was 9°. The elevational average for this association is lower than the average for the mixed brush type as a whole. This association also occurs on more gentle slopes than is average for the type (9° vs. 11°). This association occurred primarily on cooler (north and east) slope exposures, but was found more frequently on warmer (south) exposures than the Utah serviceberry-Gambel oak association. Transects sampled in this association occurred primarily on Rentsac and Rentsac-Piceance soils.

Pinus edulis was the only species encountered in the mature tree stratum, providing .16% cover and occurring at a density of 3 individuals per hectare (Table 3-7-17). The presence of Pinus edulis in this association indicates a continuity of this association with the pinyon-juniper type, where many of the same shrub species encountered in this association were also encountered in the understory of the pinyon-juniper type (Table 3-7-4).

In the shrub-tree seedling stratum (Table 3-7-15) the primary distinguishing characteristics are the high cover and density of two shrub species, Amelanchier utahensis and Symphoricarpos oreophilus (relative cover of 77%, relative density of 53%), with secondary dominance by Artemisia tridentata. Total cover for this association, 49%, is within the range of the type as a whole, but density is slightly less (12,204 vs. 13,116 and 16,829 individuals per hectare). Chrysothamnus viscidiflorus is a highly frequent constituent of this association. The high importance of Artemisia tridentata, and the presence of Juniperus osteosperma and Pinus edulis indicate the close relationship between the Utah serviceberry and snowberry association with the sagebrush and pinyon-juniper types.

In the herbaceous stratum (Table 3-7-16), during the July sampling period, 29 species contributed 11% total cover. The dominant species were two grasses, Stipa comata, Poa sandbergii, and a forb, Eriogonum umbellatum. These species contributed a relative cover of 43%. The dominant grass species reflect a drier environmental situation, since both assume greatest importance in the sagebrush and pinyon-juniper types (Table 3-7-4). Average forb density per .5 m^2 for the ten species with the greatest cover was 12.7 plants. Eriogonum umbellatum contributed the greatest density, 4 plants per .5 m^2.

The mixed brush vegetation type showed a correlation of an increase in cover with increasing elevation and a response to differences in slope and aspect (Figure 3-7-7). All transects sampled below 7,300 ft occurred on steep north or east exposures. The serviceberry-Gambel oak association occurred above the majority of the serviceberry-snowberry transects, primarily on steep north and east-facing slopes. The serviceberry-snowberry association shrub stratum showed a much wider variability in cover than did the serviceberry-Gambel oak association, indicating that a number of biotic and abiotic factors which are not identified here are contributing to the relative success of this association.

4) Pinyon-Juniper - The pinyon-juniper type was sampled with 7 permanent and 44 non-permanent transects. Shrub and tree strata were measured, when present, on all transects. A total of 330 0.5 m^2 quadrat locations was used to sample the herbaceous stratum. Seventy of these quadrats were sampled 3 times on the 7 permanent transects. Three strata and 85 species were identified for the pinyon-juniper type: 2 species in the mature tree stratum, 19 species in the shrub stratum, and 6 species in the herbaceous layer. Juniperus osteosperma and Pinus edulis occurred in both the tree and shrub strata.

The pinyon-juniper type was sampled over an elevational range of 6,500 ft to 7,660 ft, with an average elevation of 6,940 ft for the transects sampled (Table 3-7-6). Thirty-nine percent of the transects occurred on east-facing slopes, 23% on south slopes, 22% on north slopes, and 16% on west slopes. The average degree of slope for all transects was 7°.

Of the 24 transects occurring within the mapped area, 75% were sampled on the Rentsac soil series. These soils are shallow, well-drained, and are formed from sandstone. They occur on 5 to 50% slopes. Thirteen percent of the transects occurred on rock outcrops or Torriorthents. The slopes range from 12 to 90%, and are mainly south-facing along many of the drainages. These shallow soils are derived from sandstone cliffs or platy siltstone outcroppings. Eight percent of the transects occurred on a combination of Rentsac and Redcreek soil series. Redcreek soils differ from Rentsac soils in that they are derived from calcareous sandstone and have slopes of only 5 to 30%. Four percent of the transects occurred on the Rentsac, Piceance soil association. The Piceance series consists of moderately deep, well-drained soils formed from sandstone and windblown materials. These soils are on upland slopes and ridges with slopes of 5 to 15%.

In the mature tree stratum (Table 3-7-18) two species contributed 21% cover, a density of 254 individuals per hectare, and a basal area of 37 m^2 per hectare. Pinus edulis and Juniperus osteosperma shared dominance for both sampling periods. Pinus edulis contributed slightly higher cover than Juniperus osteosperma, but Juniperus osteosperma occurred at a higher relative density (56%) and contributed greater relative basal area (61%). Juniperus osteosperma constancy was equal to the constancy (88%) of Pinus edulis.

Diameters of Juniperus osteosperma individuals in the mature class (greater than 7.6 cm) ranged in size from 7.6 cm to 103 cm, measured below branch point (Table 3-7-6). The largest percentage of mature class trees (50%) were found in the 7.6-16, 16-24, and 40-48 cm size classes. When the mature and seedling-sapling classes were combined, the largest number of individuals were found in 0-7.6 cm size class, or 29% of all individuals sampled.

Diameters of Pinus edulis individuals in the mature class ranged in size from 7.6 to 80 cm measured below branch point (Table 3-7-6). The largest percentage (60%) of mature class trees were found in the 7.6-24 cm size class. When mature and shrub seedling classes are combined, 75% of all trees sampled occurred in the 0-7.6 cm size class.

In the shrub-tree seedling stratum (Table 3-7-19), 17 species provided 11% total cover, and a total density of 3,745 individuals per hectare. Artemisia tridentata was the dominant species in all transects, providing a relative cover of 44%, relative density of 45%, and occurring at a constancy of 100%. Other species with high constancy were Pinus edulis and Amelanchier utahensis. Mean volume for the dominant species Artemisia tridentata was 0.08 m^3. The largest species, Amelanchier utahensis, was estimated at 0.40 m^3. Phenology for the dominant species, Artemisia tridentata, ranged from vegetative and flower formation stages in May-June, flower formation in July, and flowering and seed formation in September. Of the 13 species sampled in May-June, 13 were in a vegetative state, 4 were forming flowers, 1 was blooming, and 1 was forming seeds. Of the 11 species sampled on the July transects, 3 were in a vegetative state, 3 were blooming and 5 were forming fruits. Of the 16 species sampled on the September transects, 8 were in a vegetative state, 4 were blooming, 6 were forming seeds, and 4 were declining.

In the herbaceous stratum (Table 3-7-20) 42 species and 2 unknowns contributed 26% total cover on the transects sampled during May-June 1975. The dominant species were three grasses, Agropyron trachycaulum, Oryzopsis hymenoides, and Poa sandbergii, together providing a relative cover of 46%. The three dominants occurred at constancies of 100, 71, and 57%, respectively. Other species with high constancies were Phlox hoodii and Haplopappus nuttallii. Of the 42 species identified during May-June, 39 were in a vegetative state, 9 were forming flowers, 3 were blooming, and 1 was forming seeds.

Thirty-nine species contributed 6% total cover during July. Three grass species, Agropyron trachycaulum, Oryzopsis hymenoides, and Poa sandbergii again shared dominance, providing a relative cover of 38%. A highly constant species not previously recorded in the pinyon-juniper type was Cryptantha sericea. Seventy-three percent of the species found in June were found again during the July sampling period. Maximum forb density was contributed by Cryptantha sericea and Sphaeralcea coccinea, both occurring at 1.3 individuals per 0.5 m^2. Generally, low sociability values for forb species indicate a dispersed and unaggregated distribution of this group. Of the 39 species encountered during July, 32 species were in a vegetative state, 2 were forming

flowers, 5 were blooming, 3 were forming seeds, 6 were dispersing seeds, and 2 were declining.

Thirty-two species contributed 4% cover in the quadrats sampled during September. Dominant species were Agropyron trachycaulum and Poa sandbergii, together providing a relative cover of 38%. Eighty-eight percent of the species found in September were also found in July. Maximum forb density was contributed by Phlox hoodii, 0.7 individuals per 0.5 m^2.

Sociability values were low for all species except Sphaeralcea coccinea, which showed a clumped distribution. Of the 32 species encountered during September, 24 were in a vegetative state, 1 was forming seeds, 2 were dispersing seeds, 3 were declining, and 4 were dead or dormant.

a) Associations - The pinyon-juniper type is represented by three major variants or associations on the study area: the pinyon pine (Pinus edulis) and Utah juniper (Juniperus osteosperma) - mixed brush association; the pinyon pine (Pinus edulis) and Utah juniper (Juniperus osteosperma) - woodland (sparse shrub understory) association; and the Utah juniper (Juniperus osteosperma)-pinyon pine (Pinus edulis)-big sagebrush (Artemisia tridentata) association. Transects sampled for the pinyon-juniper type were divided into these three associations on the basis of structural and compositional criteria. Tree and shrub data were synthesized for the three associations. Herbaceous data for July 1975 were presented to define the maximum herbaceous development for the season.

The pinyon pine (Pinus edulis) Utah juniper (Juniperus osteosperma) - mixed brush association was sampled with 12 transects, of which 8 were summarized for 1975. The herbaceous stratum was measured with a total of 120 quadrat locations, of which 20 were sampled three times. Three strata and 36 species were identified in the pinyon-juniper-mixed brush association: 2 species in the tree stratum, 15 species in the shrub stratum, and 21 species in the herbaceous stratum. Pinus edulis and Juniperus osteosperma occurred in both the tree and the shrub strata.

The pinyon-juniper-mixed brush association occupied an elevational range of 6,620 to 7,660 ft with an average elevation of 7,140 ft (Figure 3-7-6). Sixty-six percent of the transects occurred on east-facing slopes, 17% on south slopes, and 17% on north slopes. Average slope inclination for all transects was 11°. The elevational average for this association is higher than the type average (7,140 vs. 6,939 ft), and occurs on steeper slopes than the type average (11° vs. 7°). This association was sampled primarily on cooler (north and east) slope aspects. This association occurred primarily on Rentsac soils.

In the mature tree stratum (Table 3-7-21) two tree species contributed a total cover of 15%, density of 173 individuals per hectare, and provided a total basal area of 23 m^2 per hectare.

In the shrub-tree seedling stratum (Table 3-7-22) the primary criteria for distinguishing this association are:

- The occurrence of a shrub stratum with greater than 10% cover;
- of this shrub cover, Artemisia tridentata cannot contribute more than 50% of the total cover;
- shrub species are characteristically members ofthe mixed brush type (Amelanchier utahensis, Cercocarpus montanus, Purshia tridentata), but composition is not limited to these species.

Fifteen species contributed a total cover of 20%, and total density of 5,867 individuals per hectare. Of the transects sampled for this association, Amelanchier utahensis and Artemisia tridentata were dominant species, providing a relative cover of 72%, a relative density of 60%, and occurring at frequencies of 93% and 98%, respectively. Other species occurring at frequencies greater than 50% were Pinus edulis, Juniperus osteosperma, Chrysothamnus viscidiflorus, Purshia tridentata, and Symphoricarpos oreophilus. The high frequenctis of both Pinus edulis and Juniperus ostesperma indicate substantial reproduction of these species in these stands. Total cover and total density for this association are much higher than the type average (20 vs 11% cover, 5,867 vs 3,745 individuals per hectare).

In the herbaceous stratum (Table 3-7-23) 21 species contributed a total cover of 4% in quadrats sampled in July for this association. Agropyron trachycaulum was the dominant species, providing a relative cover of 32%. Nearly all herbaceous species occurred at low densities; no species exceeded a frequency greater than 35%. Astragalus diversifolius contributed the maximum density, 5.2 individuals per .5 m^2.

The pinyon pine (Pinus edulis)-Utah juniper (Juniperus osteosperma)- big sagebrush (Artemesia tridentata) association is represented by 14 transects, of which 8 were summarized for 1975. The herbaceous stratum was measured with a total of 90 quadrat locations, of which 30 were sampled three times. Three strata and 40 species were identified in the pinyon-juniper-big sagebrush association: 2 species in the tree stratum, 14 species in the shrub stratum, and 26 species in the herbaceous stratum (July sampling period only). Pinus edulis and Juniperus osteosperma occurred in both the tree and the shrub strata.

The pinyon-juniper-big sagebrush association occupied an elevational range of 1,982 m (6,500 ft) to 2,268 m (7,440 ft) with an average elevation of 2,018 m (6,620 ft) (Figure 3-7-6). Thirty-six percent of the transects occurred on east-facing slopes, 36% on south slopes, 14% on north slopes, and 14% on west slopes. Average slope inclination for all transects was 4^{0}. The elevational average for this association is lower than the type average (2,018 m (6,620 ft) vs 2,115 m (6,939 ft)), and occurs on gentler slopes than the type average (4^{0} vs 7^{0}). This association was found predominantly on south and east aspects, but does not appear to be strongly influenced by slope aspect because of gentle slope inclinations.

Transects sampled in this association occurred primarily on the Rentsac soil series.

In the mature tree stratum (Table 3-7-21), two tree species contributed a total cover of 21%, a total density of 300 individuals per hectare, and a total basal area of 25 m^2 per hectare. Juniperus osteosperma was the dominant species

with relative cover of 55%, and a relative density of 60%. This species also occurred at the highest constancy. The totals summarized above are very similar to the type averages for these parameters.

In the shrub-tree seedling stratum the primary criteria for distinguishing this association are:

- the occurrence of shrub stratum with 6% or greater cover;
- strong dominance of the shrub stratum by Artemisia tridentata (greater than 50% of the total cover);
- the occurrence of other species commonly associated with Artemisia tridentata (Chrysothamnus viscidiflorus and Purshia tridentata).

Fourteen species contributed a total cover of 9%, and a density of 4,788 individuals per hectare. The dominant species was Artemisia tridentata with a relative cover of 79%, and relative density of 53%. Other species occurring at high frequencies included Chrysothamnus viscidiflorus, Pinus edulis and Juniperus osteosperma. Densities of both Pinus edulis and Juniperus osteosperma are higher than in the juniper-pinyon-mixed brush association, indicating greater reproduction in stands dominated by sagebrush. Total cover and total density for this association are similar to the type averages for these parameters.

In the herbaceous stratum (Tables 3-7-23), 26 species contributed a total cover of 8% for the July sampling period. Agropyron trachycaulum was the dominant species, with a relative cover of 15%. Of the 10 species with the greatest cover, no species occurred at a frequency greater than 53%. Cryptantha sericea contributed the greatest forb density, 2.9 individuals per .5 m^2. Total cover was higher than the type average for July (8 vs 6%).

The pinyon pine (Pinus edulis)-Utah juniper (Juniperus osteosperma) woodland association is represented by 25 transects, of which 9 were summarized for 1975. The herbaceous stratum was measured with a total of 180 quadrat locations, of

which 20 were sampled 3 times during 1975. Three strata and 39 species were identified in the pinyon-juniper woodland association: 2 species in the tree stratum, 15 species in the shrub stratum, and 25 species in the herbaceous stratum (July sampling period only).

The pinyon-juniper woodland association occupied an elevational range of 1,993 m (6,540 ft) to 2,556 m (7,400 ft), with an average elevation of 2,103 m (6,900 ft) (Figure 3-7-6). Twenty-eight percent of the transects occurred on north-facing slopes, 24% on east-facing slopes, 24% on south slopes, and 24% on west slopes. Average slope inclination for all transects was 7^{o}. The elevational average for this association is nearly the same as the type average (2,103 m (6,900 ft) vs 2,115 m (6,939 ft)), and degree of slope is the same as the type. This association did not show a strong tendency to occur on particular slope aspects.

Transects sampled in this association occurred primarily on Rentsac soils and on rock outcrops.

In the mature tree stratum (Table 3-7-21), two tree species contributed a total cover of 27%, total density of 283 individuals per hectare, and provided a total basal area of 60 m^2 per hectare. Pinus edulis contributed the highest relative basal area; Juniperus osteosperma occurred at the highest relative density. The total values above are similar to the type average for cover and density, but are much higher for total basal area (60 vs 37-39 m^2 per hectare), indicating the presence of a number of large trees.

In the shrub-tree seedling stratum (Table 3-7-22), the primary criterion for distinguishing this association is the occurrence of a shrub stratum with less than 6% cover.

Fifteen species contributed a total cover of 3% and a density of 1,427 individuals per hectare. Purshia tridentata was the dominant species, with a relative cover of 28%, and a relative density of 23%. Other species occurring at high frequencies and densities were Artemisia tridentata, Pinus edulis, and Cercocarpus montanus. Densities of Pinus edulis and Juniperus osteosperma were lower than

the density of these species in the pinyon-juniper-big sagebrush association, indicating possible inhibition of establishment by the generally larger trees in this association. Total cover and total density values are lower for shrubs than for the type as a whole.

In the herbaceous stratum (Table 3-7-23), 24 species contributed a total cover of 4%. Poa sandbergii was the dominant species, providing relative cover of 28%. Another species occurring at relatively high frequencies was Agropyron trachycaulum. Maximum forb density was provided by Cryptantha sericea, 3.8 individuals per 0.5 m^2. Total cover and species diversity were similar to the type average for July.

The pinyon-juniper type occupied greater diversity of topographically different sites than any other type sampled. In general, pinyon-juniper stands occurred in the following types of sites:

- Along gently sloping ridges generally inclined to the east (84 Mesa, Wolf Ridge, Dead Horse Ridge). Soils range from shallow to deep.
- On steep north-facing and south-facing slopes above the gulches dissecting the study area. Soils range from extremely shallow to rocky outcrops. Based on the variability of these factors, transects were divided into groups according to degree of slope and aspect, and into the major associations based on structural and compositional criteria.

Figures 3-7-8 and 3-7-9 illustrate changes in cover and density for shrub and tree strata for the pinyon-juniper type in relation to elevation. Average cover and density values for both strata were calculated for each 500 ft interval of the range of this type in the study area. Also plotted were average cover and density for transects occurring on north slope aspects (defined as 315-90^o) and south aspects (defined as 91-314^o), and the occurrence of these transects on relatively level slopes (less than 5^o slopes), or on steeper terrain (greater than 5^o slopes). Although variance was high for all data, the general pattern indicated that shrub cover was relatively uniform (approximately 7.5-13%) with an increase in elevation, although showing very high variance

in the 2,134 m (7,000 ft) to 2,210 m (7,250 ft) range. Shrub density ranged around 4,500 individuals per hectare at the lower elevations (1,981 m (6,500 ft) to 2,057 m (6,750 ft)), but then dropped sharply in the 2,057 m (6,750 ft) to 2,210 (7,250 ft) range to 2,500 to 3,000 individuals per hectare and increased to more than 5,000 individuals per hectare in transects above 2,210 m (7,500 ft). Tree cover increased from approximately 20% between 1,981 m (6,500 ft) and 2,057 m (6,750 ft) to nearly 30% between 2,134 m(7,000 ft) and2,210 m (7,250 ft) then dropped sharply to less than 23% above 2,210 m (7,250 ft). No strong correlations between cover and density for shrubs and trees with slope and aspect were apparent from the data. The pattern of these data was similar to results obtained by West, et al. (1975) in an ordination of pinyon-juniper transects in the Great Basin and Colorado Plateau. They found that a maximum tree cover for pinyon and juniper occurred 2,200 m (approximately 7,200 ft). A nearly identical result was obtained in this study, with maximum average tree cover for transects sampled occurring at approximately 2,195 m (7,200 ft). West, et al. (1975) found that shrub stratum cover dropped to less than 1% at the point of maximum tree cover. Shrub cover did not show a corresponding drop at the point of maximum tree cover. Shrub cover did not show a corresponding drop at the point of maximim tree cover in the study area, remaining above 5%. Density data for the study area indicated that a large drop in density for shruabs occurred at the point of maximum tree cover, implying that shrub cover may have largely been provided by large, widely spaced shrubs.

Changes in cover with elevation in relation to structure and composition of associations identified in the study area are discussed below. Figures 3-7-10, 3-7-11, and 3-7-12 present shrub and tree cover of individuals transects, with the addition of slope inclination and aspect information. Ordination by structural and compositional criteria against elevation explained some of the variability in the data which was not apparent from the ordination of the type as a whole.

The pinyon-juniper woodland (sparse understory) association (Figure 3-7-10) show a very wide elevational occurrence, with a maximum number of transects occurring between 2,104 m (6,800 ft) and 2,210 (7,250 ft). The juniper-pinyon-woodland association shows the highest average tree cover of any

association, and the lowest shrub cover, indicating a strong influence on the understory by larger pinyon and juniper trees. Cover is not strongly correlated with increase in basal area, nor is it strongly correlated with an increase in density.

The pinyon-juniper-mixed brush association (Figure 3-7-11) shows a very wide elevational distribution, but the majority of transects sampled occurred above 2,134 m (7,000 ft). Those occurring below 2,195 m (7,200 ft) appear to be influenced by slope aspect and slope inclination: all transects occurred on steeper (greater than 5° slopes), and cooler (north and east exposures) slopes. In general, the occurrence of high shrub cover is correlated with low tree cover, indicating either disturbed sites, or areas transitional toward mixed brush stands.

There appears to be some correlation between the occurrence of the pinyon-juniper-big sagebrush association (Figure 3-7-12) with elevation, with most transects sampled occurring below 2,066 (6,775 ft). A few transects with understories dominated by sagebrush were encountered above 2,256 m (7,400 ft), indicating intergradation with upland sagebrush stands at the upper limits of pinyon-juniper distribution.

West, et al. (1975) also found that cover values for sagebrush increased at the upper limits of the pinyon-juniper type in transects sampled in the Great Basin and Colorado Plateau.

5) Sagebrush - The sagebrush type was sampled with 7 permanent and 41 non-permanent transects. Shrub and tree strata when present were measured on all transects. A total of 300, 0.5 m^2 quadrat locations was used to sample the herbaceous stratum. Seventy of these quadrats were sampled three times on the seven permanent transects. Three strata and 117 species were identified for the sagebrush typ: 2 species in the mature tree stratum, 17 species in the shrub stratum, and 100 species in the herbaceous layer. *Pinus edulis* and *Juniperus osteosperma* occurred in both the tree and shrub strata.

The sagebrush type was sampled over an elevational range of 1,957 m (6,420 ft) to 2,616 m (8,580 ft) with an average elevation of 2,165 m (7,100 ft) for the transects sampled (Figure 3-7-6). Thirty-three percent of the transects occurred on north-facing slopes, 30% occurred on east-facing slopes, 17% occurred on south slopes, and 20% occurred on west slopes. The average degree of slope for all transects was 4^{o}.

Thirty-five percent of the 23 transects sampled within the mapped area occurred on the Glendive soil series. These are deep, well-drained valley soils formed in alluvial material with slopes of 2 to 9%. Thirty percent of the transects occurred in Rentsac soils. These are shallow, well-drained, sandstone-derived soils on foothills with slopes of 5 to 50%. Twenty-six percent of the transects occurred on a combination of Rentsac and Piceance soils. The Piceance soils are moderately deep, well-drained upland soils derived from sandstone and windblown materials on ridges and slopes of 5 to 15%. Four percent of the transects occurred on rocky outcrops and Torriorthent soils. These shallow soils are derived from sandstone cliffs or platy silstone outcrops on south-facing slopes of many drainages. These slopes are usually steep, ranging from 12 to 90%.

Mature trees of Pinus edulis and Juniperus osteosperma contributed zero total cover, a total density of two individuals per hectare, and a total basal area of 0.27 m^2 per hectare. Juniperus ostepsperma occurred at a slightly higher constancy than Pinus edulis (8 vs. 4) (Table 3-7-24).

In the shrub stratum (Table 3-7-25), 17 species provided 34% total cover, and total density of 13,925 individuals per hectare. Artemisia tridentata was the dominant species contributing 73% rleative cover, and relative density of 59%. Artemisia tridentata occurred at a constancy of 100%. Other species with a high constancy were Chrysothamnus viscidiflorus and Amelanchier utahensis. Mean volume for Artemesia tridentata was 0.20 m^3; the largest species, Amelanchier utahnesis, was estimated at 2.17 m^3. Phenology for the dominant species, Artemisia tridentata, ranged from vegetative in May-June, flower formation during July, and flowering, seed formation, and dissemination during September. Of the 14 species sampled in May-June, 13 were in a vegetative state, 2 were leafing out, and 2 were dormant. Of the 10 species

sampled in July, 5 were in a vegetative state, 3 were forming flowers, 1 was flowering, and 2 were forming seeds or fruits. Of the 14 species sampled in September, 10 were in a vegetative state, 4 were flowering, 4 were forming seeds, 6 were disseminating seeds, and 3 species were declining.

In the herbaceous stratum, 62 species contributed 7% total cover during May-June. The dominant species were a grass, Poa sp., and a perennial forb, Phlox hoodii. Together these two species contributed relative cover of 33%, and occurred at constancies of 86 and 14%, respectively. Other species showing relatively high cosntancies were Agropyron sp. and Sisymbrium sp. Of 62 species identified during May-June, 2 were emerging from the soil, 53 were in a vegetative state, 17 were forming flowers, 5 were flowering and 1 was forming seeds.

During July, 60 species contributed 17% cover. Dominant species were two grasses, Poa sandbergii and Agropyron smithii, and a forb, Lupinus caudatus. The three species together contributed a relative cover of 34%, and occurred at constancies of 43, 86, and 43% respectively. Other species with high constancies were Phlox longifolia, Crypthntha sericea, and Chenopodium fremontii. Sixty-one percent of the species found in the June quadrats were again encountered in July. Galium boreale contributed maximum forb density, 2.9 individuals per 0.5 m^2. Generally low sociability values for all species except Galium boreale and Erigeron speciosus indicate a generally dispersed, and non-aggregated distirubtion pattern for herbaceous forbs. Of the 60 species encountered during July, 32 were in a vegetative state, 12 were forming flowers, 16 were flowering, 16 were forming seeds, 12 were dispersing seeds, and 6 were declining.

Forty-three species contributed a total cover of 14% during September. Dominant species over the type were Poa sandbergii, Koeleria gracilis, and Lupinus caudatus, together providing 21% relative cover, and occurring at a constancy of 50% for all three species. Other highly constant species were Oryzopsis hymenoides, and a species of moss. Seventy-nine percent of the species found in September were also found in the July transects. Galium boreale contributed maximum forb density, 2.6 individuals per 0.5 m^2.

Sociability values were low for all species except Galium boreale and Lepidium montanum, which grew in clumps. Of the 43 species encountered during September, 30 were in a vegetative state, 5 were dispersing seeds, 9 were declining, and 6 were dormant or dead.

a) Associations - The sagebrush type is represented by four major variants or associations on the study area: the bottomland big sagebrush association, the upland big sagebrush association, the rabbitbrush association, and the greasewood association.

Transects sampled for the sagebrush type were divided into these four associations on the basis of structural, compositional, topographic and successional criteria. Tree and shrub data were synthesized for the upland and bottomland sagebrush associations. Herbaceous data for July were presented to define the maximum herbaceous development for the season for these two associations. The rabbitbrush and greasewood associations, because of their treatment as types in the past, were treated separately as types in the sections that follow. The relationships between these associations, and the sagebrush type, are discussed under separate sections.

The bottomland big sagebrush association is represented by 17 transects, of which 9 are summarized. The herbaceous stratum was measured with a total of 110 quadrat locations, of which 30 were sampled 3 times. Two strata and 33 species were identified for the bottomland big sagebrush association· 12 shrub species, and 21 herbaceous species (July sampling period only).

The bottomland big sagebrush association occupied an elevational range of 1,957 (6,420 ft) to 2,371 (7,780 ft), with an average elevation of 2,104 m (6,900 ft). Forty-one percent of the transects occurred on north-facing slopes, 31% on west slopes, 24% on east slopes, and 3% on south slopes. Average slope inclination for all transects was 4^{0}. The elevational average for this association is lower than for the type as a whole (2,104 m (6,900 ft) vs. 2,165 m (7,100 ft)), and slope inclination is the same as that for the type. Transects sampled in this association occurred primarily on Glendive soils.

The primary criterion used to distinguish this association is the occurrence of sagebrush-dominated areas on valley-bottom or alluvial soils (Table 3-7-27). Bottomland sage associations are generally distinguished from adjacent upland sage associations by the taller stature of big sagebrush, and the frequent presence of shrub species adapted to saline or alkaline soils (Sarcobatus vermiculatus, Atriplex confertifolia).

Twelve species contributed a total cover of 43%, and a total density of 18,880 individuals per hectare. Artemisia tridentata was the dominant species, providing a relative cover of 73%, a relative density of 56% and occurred at a frequency of 100%. Other highly frequent species were Chrysothamnus viscidiflorus and Symphoricarpos oreophilus. Total cover and density for this association was higher than for the type as a whole (43 vs. 34% cover, 18,880 vs. 14,000 individuals per hectare).

Twenty one species contributed a total herbaceous stratum cover of 5% during July, 1975. Agropyron smithii and Elymus cinereus were the dominant species, providing relative cover of 64%, and occurring at frequencies of 20 and 17%, respectively. Other frequent species with lower cover values were Sitanion longifolium and Lepidium perfoliatum. Of the ten species with the greatest cover, 5 were annual sepcies. Lepidium perfoliatum contributed the maximum forb density, 4.3 individuals per 0.5 m^2. Total cover values were less than for the type as a whole during July (5 vs. 17%) (Table 3-7-28).

The upland big sagebrush association is represented by 31 transects of which 16 were summarized for 1975. The herbaceous stratum was measured with a total of 190 quadrat locations of which 40 were sampled 3 times during 1975. Two strata and 66 species were identified for the upland big sagebrush association: 15 shrub species and 51 herbaceous species.

The upland big sagebrush association occupied an elevational range of 1,981 m (6,500 ft) to 2,601 m (8,530 ft), with an average elevation of

2,195 m (7,200 ft) (Figure 3-7-6). Forty-one percent of all transects occurred on north-facing slopes, 31% on west slopes, 24% on east slopes, and 3% on south slopes. Average slope inclination for all transects was 4^{o}. The elevational average for this association is slightly higher than the type average (2,195 m (7,200 ft) vs. 2,165 m (7,100 ft)), and degree of slope is the same as that for the type. Transects sampled in this association occurred primarily on Rentsac and Rentsac-Piceance soils.

The primary criterion used to define this association is the occurrence of sagebrush-dominated areas on gentle valley side slopes, and on ridgetops. Upland sagebrush associations are further distinguished from adjacent bottomland sagebrush associations by their generally lower stature, and the frequent presence of shrub species that are constituents of the mixed brush and pinyon-juniper types.

Fifteen species contributed a total cover of 30%, and total density of 9,345 individuals per hectare. Artemisia tridentata was the dominant species, providing a relative cover of 73%, relative density of 60%, and occurring at 98% frequency. Other frequent species were Chrysothamnus visicidiflorus, Amelanchier utahnesis, and Symphoricarpos oreophilus. The presence of young Pinus edulis and Juniperus osteosperma indicates the capacity of these species to successfully invade upland sagebrush areas. Total cover was similar and total density less than the type as a whole (9,345 vs 14,000).

Fifty-one species contributed a total herbaceous stratum cover of 26% during July 1975 (Table 3-7-28). Lupinus caudatus and Poa sandbergii were the dominant species showing high frequency on these transects was Agropyron smithii. Of the 10 species with greatest cover, all 10 are perennial species. Galium boreale contributed maximum forb density, 10.1 individiual per 0.5 m^2.

Due to differences in physiognomy, stand density, and cover, the transects in the sagebrush type were divided between upland and bottomland stands for graphical presentation (Figures 3-7-13 and 3-7-14). Shrub and herbaceous cover were plotted alone against elevation, since no transects were taken on steep slopes and no strong tendency for transect slope aspects to be grouped

around particular directional quardrants were apparent from the data. Shrub cover showed great variability for both bottomland and upland a associations. Mean cover and elevation and their standard deviations were calculated for each 500 ft interval for the plotted points. The mean cover values, although showing great variance, indicate that there may be a tendency for upland sagebursh shrub cover to increase slightly with altitude, from approximately 2,200 m^2 per hectare at 2,012 m (6,600 ft) to 2,750 m^2 per hectare at 2,332 m (7,650 ft). The bottomland sagebrush stands showed no consistent responses to altitude. The variability in bottomland sagebrush stands may be related in part to the differential proximity of the root systems of sampled plants to deep sources of water along gully bottoms as well as the factor of human and animal disturbance along valley bottoms. The major observation that can be drawn from the shrub cover data is the much higher cover of the bottomland sage association over the upland sage association. Herbaceous cover in the bottomland sage association is uniformly low, but herbaceous cover generally increases with altitude in the upland sagebrush transects, whcih may be a response to greater precipitation and generally lower shrub competition.

6) Greasewood - The greasewood type was sampled with 3 permanent and 10 non-permanent transects. Shrub and tree strata, when present, were measured on all transects. A total of 70 0.5 m^2 quadrats were used to sample the herbaceous stratum. Thirty of these quadrats were sampled 3 times on the 3 permanent transects. Two strata and 26 species were identified for the greasewood association type: 7 species in the shrub stratum, and 19 species in the herbaceous layer.

Greasewood occurs as small isolated patches within the bottomland sagebrush association. Because of the limited distribution of this type and its close relationship with sagebrush communities, the greasewood type is also considered an association within the sagebrush type within the boundaries of the study area.

The greasewood type was sampled over an elevational range of 1,890 m (6,200 ft) to 2,134 m (7,000 ft), with an average elevation of 1,996 m (6,550 ft) for

the transects sampled (Figure 3-7-6). Forty-six percent of the transects occurred on south-facing slopes, 38% on east slopes, and 16% on north slopes. The average degree of slope for all transects was 2^{0}.

Of the four transects occurring within the mapped area, 75% occurred in the Glendive soil series. These soils are deep, well-drained, and formed in alluvial materials. They are in valleys with slopes of 2 to 9%. Twenty-five percent of the transects occurred on the Harve soil series. These soils are deep, well-drained, and formed in calcareous mixed alluvium. They occur on flood plains and low terraces with slopes of 0 to 8%.

In the shrub-tree seedling stratum (Table 3-7-29), 5 species contributed 44% total cover and total density of 9,504 individuals per hectare. Artemisia tridentata and Sarcobatus vermiculatus were the dominant species, together contributing a relative cover of 91%, and relative density of 79%. Both species occurred at a constancy of 100%. Other frequent associates were Chrysothamnus nauseosus, Chrysothamnus viscidiflorus, and Atriplex confertifolia. Estimated mean volume of Sarcobatus vermiculatus was 0.65 m^3; Artemisia tridentata was estimated at 0.16 m^3, indicating the larger size of the Sarcobatus. One of the dominant species, Sarcobatus vermiculatus, was vegetative during May-June and July, and was disseminating seeds in September. Of the 5 species sample during May-June, all were in a vegetative state. Of the 4 species sampled during July, 2 were in a vegetative state, and 2 were forming flowers. Of the 3 species encountered in September, 1 was blooming, 2 were forming seeds, and 1 was disseminating seeds.

In the herbaceous stratum (Table 3-7-30), 11 species contributed 12% cover during May-June. Two annual forbs, Lappula redowskii and Chenopodium fremontii, were the predominant species over the type, contributing relative cover of 47%. Other species with high constancies were Descurainia pinnata and Agropyron smithii. Of the 11 species sampled in May-June, 6 were in a vegetative state and 3 were forming flowers.

Thirteen species contributed 29% cover during July 1975. An annual forb, Kochia iranica, was the dominant species, with a relative cover of 32%. Other species with high constancy in this type were Chenopodium album, Agropyron smithii, and Chenopodium fremontii. Eighty-two percent of the species encountered in May-June were found again in July. Sociability values were high for Kochia iranica, Chenopodium album, and Chenopodium fremontii, indicating a clumped distribution for these species. Kochia iranica contributed the maximum forb density, 35.1 individuals per 0.5 m^2 Of the 13 species sampled in July, 8 were in a vegetative state, 2 were forming flowers, 3 were forming seeds, and 2 were declining.

Thirteen species contributed a total cover of 17% during September 1975. Kochia iranica and Chenopodium fremontii were the dominant species over the type, providing a relative cover of 55%, and occurring at constancies of 33 and 100%. Density of Kochia iranica and Chenopodium fremontii remained high, in concordance with previous sampling. Of the 13 species sampled during September, 7 were in a vegetative state, 1 was flowering, 1 was forming and disseminating seeds, and 5 species were declining or dormant.

7) Rabbitbrush - The rabbitbrush type was sampled during 1974 and 1975 with two permanent and nine non-permanent transects. Shrub and tree strata were measured on all transects. A total of 70, 0.5 m^2 quadrats were used to sample the herbaceous stratum. Twenty of these quadrats were sampled three times on two permanent transects. Two strata and 33 species were identified for the rabbitbrush type: 7 species in the shrub stratum, and 26 species in the herbaceous layer.

The rabbitbrush communities sampled in the study area represent a seral stage in the bottomland sagebrush association. Field observations and previous work in this area (Vories, 1972) indicate that high density rabbitbrush stands are the result of rapid invasion by rabbitbrush (Chrysothamnus) species into abandoned agricultural or burned sites which were formerly dominated by Artemisia tridentata. Since Artemisia tridentata provides little cover, but high density in the sampled rabbitbrush stands (Table 3-7-31), it may be inferred that big sagebrush seedling are reinvading many of these rabbitbrush-dominated sites. Because of this interrelationships between

Artemisia and Chrysothamnus, the rabbitbrush type is considered a variant, or association of the bottomland sagebrush association, but is treated as a type to maintain consistency with other aspects of the study program. The rabbitbrush type was sampled over an elevational range of 1,921 m (6.300 ft) to 2,098 m (6,880 ft), with an average elevation of 6,610 ft for the transects sampled (Figure 3-7-6). Fifty-four percent of the transects occurred on north-facing slopes, 38% on south slopes, and 8% on east slopes. The average degree of slope for all transects was 1^{o}.

Of the seven transects occurring within the mapped area, 57% occurred on the Harve soil series. These soils are deep, well-drained, and formed in calcareous mixed alluvium. They occur on floodplains and low terraces with slopes of 0 to 8%. Forty-three percent of the transects occurred on the Glendive soils series. These soils are deep, well-drained, and formed in alluvial materials. They are in valleys with slopes of 2 to 9%.

In the shrub stratum (Table 3-7-31), 6 species contributed 39% cover, and total density of 13,835 individuals per hectare. Chrysothomnus visciflorus and Chysothamnus nausesus were the dominant species, providing 91% relative cover and a relative density of 68%, and occurring at a constancy of 63 and 88%, respectively. Mean volume for Chrysothamnus viscidiflorus was estimated at 0.02 m^3; Chrysothamnus nauseous was estimated at 0.34 m^3. The two dominant species, Chrysothamnus viscidiflorus and C. nauseousus, were in a vegetative state during May-June, were forming flowers during July and were flowering or forming seeds during September. Of the 3 species encountered in July, all 3 were forming flowers. Of the 4 species encountered in September, 2 were in a vegetative state, 3 were flowering, 3 were forming seeds, 2 were disseminating seeds, and 1 was declining.

In the herbaceous stratum (Table 3-7-32), 13 species and one unknown contributed 26% total cover during May-June 1975. A perennial grass, Elymus cinereus, was the dominant species over the type, contributing 79% relative cover, and occurring at a constancy of 100. Of the 13 species encountered during May-June, 9 were in a vegetative stage. 5 were forming flowers, 3 were flowering, and 1 was forming seeds.

Nine species and one unknown contributed 44% total cover during July 1975. Elymus cinereus was again the dominant species, contributing 84% relative cover. Chenopodium fremontii contributed maximum forb density, 0.6 individuals per 0.5 m^2. Of the nine species identified during July, 3 were in a vegetative state, 5 were disseminating seeds, and 1 was declining.

Twelve species contributed 29% total cover during September. Elymus cinereus was again the dominant species, providing 62% relative cover. Chenopodium fremontii again contributed maximum forb density, 0.7 indiviudals per 0.5 m^2. Of the 12 species encountered during September, 3 were in a vegetative state, 2 were flowering, 3 were forming seeds, 3 were disseminating seeds, and 6 were declining, dormant, or dead.

8) Bald - The bald type was sampled with 2 permanent and 13 non-permanent transects. Shrub and tree strata, when present were measured on all transects. A total of 120, 0.5 m^2 quadrats was used to sample the herbaceous stratum. Twenty of these quadrats were sampled three times on two permanent transects. Three strata and 75 species were identified for the bald type: 2 species in the mature tree stratum, 14

species in the shrub stratum, and 61 species in the herbaceous layer. _Pinus edulis_ and _Juniperus osteosperma_ occurred in both the tree and shrub strata.

The bald type was sampled over an elevational range of 2,231 m (7,320 ft) to 2,606 m (8,550 ft), with an average elevation of 8,310 ft for the transects sampled (Figure 3-7-6). Eighty percent of the transects occurred on west-facing slopes, 20% on south-facing slopes. The average degree of slope for all transects was 8^{0}.

Of the four bald transects sampled within the mapped area, 75% occurred on a combination of Rentsac and Piceance soil associations. The remaining 25% occurred on the Rentsac soil series. Both series are on foothills, upland slopes, and ridges, which are derived from sandstone, and are well-drained. The Rentsac soils are shallow, with slopes of 5 to 15%.

Pinus edulis provided no cover, a density of 5 individuals per hectare, a basal area of 4 m^2 per hectare, and occurred at a constancy of 33% (Table 3-7-33).

In the shrub-tree seedling stratum (Table 3-7-34), 13 species provided 5% total cover, and a total density of 1,515 individuals per hectare. _Artemisia frigidia_ was the dominant species, providing a relative cover of 56%, relative density of 66%, and occurring at a constancy of 45%. Other highly constant species which contributed high density but low cover were _Tetradymia canescens_, _Symphoricarpos oreophilus_, and _Chrysothamnus viscidiflorus_. Mean volume for _Amelanchier utahensis_ was 10.89 m^3, and for _Purshia tridentata_ was .05 m^3. Of these seven species sampled

during May-June, all were in a vegetative state. Of the 8 species sampled in July, 7 were vegetative, and 2 were forming flowers. Of the eight species sampled during September, 2 were in a vegetative state, 4 were forming seeds, 5 were disseminating seeds, and 2 were declining.

In the herbaceous stratum (Table 3-7-35), 43 species contributed 9% cover in the quadrats sampled in June. Two species of perennial grasses Agropyron trachycaulum and Koeleria gracilis, shared dominance over the type providing a relative cover of 30%. Other highly constant species were Gutierrezia sarothrae, and Trifolium gymnocarpon. Of the 43 species sampled during May-June, 36 were in a vegetative state, 13 were forming flowers, and 6 were flowering.

Forty-six species contributed 21% cover during July. Agropyron trachycaulum, Koeleria gracilis, Astragalus spatulatus, and Penstemon caespitosus were the dominant species over the type providing relative cover of 35% and occurring at constancies of 80, 100, 100, and 100%. Other highly constant species were Poa sandbergii and Hymenoxys acaulis. Sixty-eight percent of the species encountered in the May-June transects were found again in the July transects. Maximum forb density was contributed by Hymenoxys acaulis, 4.9 individuals per 0.5 m^2. Sociability values were low for all forb species, indicating a dispersed and heterogeneous distribution of this group. Of the 46 species encountered in July, 29 were in a vegetative state, 9 were forming flowers, 12 were flowering, 15 were forming seeds, 14 were dispersing seeds, and 7 species were declining.

Twenty-three species contributed 17% total cover during September. Poa sandbergii, Haplopappus acaulis, and Agropyron trachycaulum were the dominant species over the type, providing a relative cover of 57% and all occurring at a constancy of 100%. Ninety-six percent of the species found in September were also found during July. Haplopappus acaulis contributed the maximum forb density, 4.8 individuals per 0.5 m^2. Sociability values were low in concordance with previous sampling. Of the 23 species encountered in September, 21 were in a vegetative state, 2 species were disseminating seeds, 2 were declining, and 1 was dead or dormant.

9) <u>Shadscale</u> - The shadscale type was sampled with two permanent and seven non-permanent transects. Shrub and tree strata, when present, were measured on all transects. A total of 60, 0.5 m^2 quadrat locations were used to sample the herbaceous stratum. Twenty of these quadrats were sampled three times on the two permanent transects. Three strata and 33 species were identified for the shadscale type: one species in the mature tree stratum, 13 species in the shrub stratum, and 19 species in the herbaceous layer.

The shadscale type was sampled over an elevational range of 6,460 feet to 6,810 feet, with an average elevation of 6,600 feet for the transects sampled (Figure 3-7-6). Eighty-eight percent of the transects occurred on south-facing slopes, and 12% on east-facing slopes. The average degree of slope for all transects was 17^o.

Of the three transects that occurred within the mapped area, 100% occurred on rock outcrops and Toriorthent soils. These shallow soils are derived from sandstone cliffs or platy siltstone outcrops on south-facing slopes of many drainages. The slopes are usually steep, from 12 to 90%.

<u>Juniperus osteosperma</u> was the only tree species occurring in the mature tree stratum, providing 3% cover in 1975, a density of 30, and basal area of 2 m^2 per hectare (Table 3-7-36).

In the shurb-tree seedling stratum (Table 3-7-37) twelve species contributed 14% total cover, and total density of 5,603 individuals per hectare. Dominant species over the type were <u>Artemisia tridentata</u> and <u>Atriplex confertifolia</u>, contributing relative cover of 83%, and a relative density of 66%, and occurring at a constancy of 100%. Other highly constant species were <u>Tetradymia canescens</u>, <u>Sarcobatus vermiculatus</u>, and <u>Chrysothamnus nauseosus</u>. Mean volume for <u>Atriplex confertifolia</u> was 0.01 m^3, and 0.17 m^3 for <u>Artemisia tridentata</u>. Of the nine species sampled in May-June, all were in a vegetative state. Of the nine species sampled in July, five were in a vegetative state, and four were forming flowers. Of the seven species sampled in September, three were in a vegetative state, one was forming flowers, two were flowering, four were forming seeds, and one was disseminating seeds.

In the herbaceous stratum (Table 3-7-38) nine species contributed less than 1% cover on the May-June transects. Two perennial forbs, Eriogonum lonchophyllum and Artemisia frigida, were the dominant species over the type, contributing a relative cover of 53%. Of the nine species sampled during May-June, all were in a vegetative state.

Nine species contributed 3% cover in quadrats sampled in July. Eriogonum lonchophyllum and Haplopappus nuttallii were the dominant species over the type, contributing a relative cover of 69%, and occurring at a constancy of 50%. Other species found on both transects were Oryzopsis hymenoides and Sitanion longifolium. Sixty-seven percent of the species encountered in June were found again in July. Eriogonum lonchophyllum contributed maximum forb density, 2.9 individuals per 0.5 m^2. All species occurred at low densities and frequencies. Of the nine species encountered during July, six were in a vegetative state, one was forming flowers, one was flowering, one was forming seeds, and one was disseminating seeds and declining.

Eight species contributed 2% cover in the quadrats sampled during September. Eriogonum lonchophyllum was again the dominant species, providing a relative cover of 48%. Of the eight species encountered in September, four were in a vegetative state, one was blooming, one was declining, and two were dead or dormant.

10) Riparian - The riparian type was sampled with three permanent and ten non-permanent transects. Shrub and tree strata, when present, were measured on all transects. A total of 100, 0.5 m^2 quadrats were used to sample the herbaceous stratum. Thirty of these quadrats were sampled three times on the three permanent transects. Three strata and 89 species were identified for the riparian type: one species in the mature tree stratum, 20 species in the shrub stratum, and 69 species in the herbaceous layer. Populus tremuloides occurred in both the tree and shrub strata.

The riparian type was sampled over an elevational range of 6,350 feet to 7,600 feet, with an average elevation of 6,800 feet for the transects sampled (Figure 3-7-6). Fifty percent of the transects occurred on east-facing slopes, 40% on

north slopes, and 10% on south slopes. The average degree of slope for all transects was 3^0.

Of the four transects occurring within the mapped area, 75% occurred on the Harve soil series. These soils are deep, well-drained, and formed in calcareous mixed alluvium. They occur on flood plains and low terraces with slopes of 0 to 8%. Twenty-five percent of the transects occurred on the Glendive soils series. These soils are deep, well-drained, and formed in alluvial materials. They occur in valleys with slopes of 2 to 9%.

In the mature tree stratum, Populus tremuloides was the only tree species recorded (Table 3-7-39). It contributed 3% total cover, a density of 33 per hectare, and a basal area of 0.12 m^2 per hectare. A few large individuals of Populus angustifolia were observed at Cottonwood Spring, T15, R99W, Section 19, but were not encountered in the sampling transects.

In the shrub-tree seedling stratum (Table 3-7-40) 19 species contributed a total cover of 26%, and total average density of 5,203 individuals per hectare. Artemisia tridentata and Chrysothamnus nauseosus were the dominant species in 1975 samples, providing relative cover of 29%, a relative density of 36%, and occurring at constancies of 67 and 89%, respectively. Mean volume for Chrysothamnus nauseosus was 0.02 m^3. The dominants listed above were most frequent along intermittent washes and gullies within the study area. In isolated springs a number of more characteristic riparian species were found, including Betula fontinalis, Salix exigua, Salix interior, and Swida sericea. Of the nine species found during May-June, seven were in a vegetative state, four were forming flowers, and one was flowering. Of the 12 species found during July, five were in a vegetative state, three were forming flowers, one was flowering, eight were forming seeds, and three were disseminating seeds. Of the 14 species encountered in Spetember, nine were in a vegetative state, one was flowering, three were forming seeds, and seven were disseminating seeds.

In the herbaceous stratum (Table 3-7-41) 21 species contributed 50% total cover during May-June. Agropyron repens was the dominant species, providing 71% relative cover, and occurring at a constancy of 75%. Other highly constant

species were Taraxacum officinale, Poa pratensis, and Juncus balticus. Of the 21 species encountered in May-June, 17 were in a vegetative state, three were forming flowers, four were flowering, and one species was forming seeds. Thirty-five species and one unknown provided 57% cover during July. A perennial grass, Agropyron repens, was again the dominant species, providing 24% relative cover. The large increase in the number of herbaceous species during July is the result of additional herbaceous sampling on two non-permanent transects. Other species with high constancy were Poa pratensis and Taraxacum officinale. Kochia iranica contributed maximum forb density, 2.2 individuals per 0.5 m^2. Sociability values were high for Kochia iranica, Smilacina stellata, and Solidago sp., indicating that these species were clumped, and infrequently encountered. Of the 35 species identified for July, 16 were in a vegetative state, two were forming flowers, 13 were flowering, 19 were forming seeds, and three were disseminating seeds.

Twenty-five species contributed 85% total cover during September. Two perennial grasses, Elymus cinereus and Agropyron repens, were the dominant species, providing relative cover of 70%, and occurring at a constancy of 67%. Other species with high constancies were Erigeron speciosus, Carex lanuginosa and Taraxacum officinale. Maximum forb density was contributed by Erigeron speciosus, 26.8 individuals per 0.5 m^2. Of the 25 species encountered during September, ten were in a vegetative state, one was forming flowers, three were flowering, five were forming seeds, eight were disseminating seeds, and six species were declining, dead or dormant.

4. Discussion

a. Literature Review - Published literature on the vegetation of the Tract C-a study area is sparse (Ward and Slauson, 1972). The dominant vegetation of the Douglas-fir, pinyon-juniper and oak-mountain mahogany zones of the Rocky Mountains is described by Daubenmire (1943), Oosting (1956) and Billings (1966). The desert flora and vegetation typical of the Great Basin Desert to the west of the study area are described by Shreve (1942), Oosting (1956), Billings (1966) and Fautin (1946). Economically important forage types and species for the Rocky Mountain area are described by Costello (1944).

Earlier studies of the area were conducted mainly by the Bureau of Land Management (BLM) and the Soil Conservation Service (SCS). The BLM vegetation maps are general, distinguishing only three vegetation types: pinyon-juniper, sagebrush and mountain shrub (Ward and Slauson, 1972).

Regional studies include reports prepared for the Oil Shale Surface Rehabilitation Study by Ward et al. (1973) and by Terwilliger (1973). Ward et al. (1973) included a classification scheme of major vegetation types with observations of community composition and structure, diversity, productivity, horizontal and vertical patterns, scale of vegetation mosaic, and ecological amplitude for selected species. A similar identification scheme was prepared by Terwilliger (1973) including a plant list with 117 species.

A more intensive study providing quantitative information on community composition and structure was conducted by Ferchau (1973) on the Colony Development Operation properties in the upper Parachute Creek drainage from 1971-73. The most recent regional study identified and classified 35 associations in the five major climate zones represented in the study area (Vories, 1974). This study quantified the structure, composition and topographic components of each association and graphically portrayed the ecological amplitudes of the 413 species identified in the study.

b. <u>Climate</u> - The elevation of the Tract C-a study area ranges from a low of 1,890 m (6,200 ft) at the junction of Duck Creek and Yellow Creek to a high of 2,644 m (8,675 ft) on Cathedral Bluffs near the headwaters of Spruce Gulch. The climate of the area is classified as arid steppe and is characterized by abundant sunshine during all seasons, insufficient precipitation for vigorous vegetative growth, warm summer temperatures and low relative humidity (Marlatt, 1973).

The scarcity of precipitation, hot summers and incidence of thunderstorms (Marlatt, 1973) has been conducive to fires from lightning and human carelessness. The incidence of fire was noted most commonly in the pinyon-juniper type, but was also evident in some Douglas-fir stands. Precipitation in the

Piceance Basin ranges from 28 cm (11 in) in the northwest corner to 64 cm (25 in) on the Roan Plateau. The major portion of the Piceance Basin receives 36 to 38 cm (14 to 15 in) of precipitation, with about equal monthly distribution (Terwilliger, 1973).

c. Soils - The soils of the study area are part of the plateau land type within the Piceance Basin. These soils are derived from Evacuation Creek sandstones, shales and marls. The soils are primarily formed in place except for the alluvial deposits found in most of the drainages. The plateau soils are generally shallow sandy loams that range in depth from almost zero on rock outcrops to more than 61 cm (24 in) under dense aspen stands (Thorne Ecological Institute, 1973). The major influence of soils on vegetation in the study area has been the dominance of desert shrub types on alluvial wind-deposited or saline-sodic soils. Forest, mountain shrub, or woodland types dominate the residual soils.

d. Floristics - The flora identified in the Tract C-a study area during 1974-1975 includes five tree species, 36 shrub species, and 169 herbaceous species, of which 46 species are classified as grass or grass-like (Table 3-7-3). Three species included in the flora require special notation. A milkvetch, Astragalus lutosus, is on the Smithsonian Institution endangered plant species list (Smithsonian Institution, 1975) and was located near Cottonwood Springs on Big Duck Creek. Aquilegia barnebyi, a columbine endemic to the Green River formation (Munz, 1949), was located near Cottonwood Springs on Big Duck Creek. Colorado columbine, Aquilegia caerulea, (Harrington, 1964) is the state flower and was located in most of the aspen stands and some of the more mesic mixed brush and Douglas-fir stands near Cathedral Bluffs.

e. Phytogeography - The flora of the Tract C-a vicinity is primarily a combination of members of the tropically derived desert species of the Madro-Tertiary flora and the boreally derived forest species of the Arcto-Tertiary flora (Axelrod, 1940; 1958).

The dominant species of these flora form a mosaic of plant associations representative of two major vegetation formations: the cold desert formation (Oosting, 1956), dominated by big sagebrush (Artemisia tridentata), shadscale (Atriplex confertifolia), and black greasewood (Sarcobatus vermiculatus); and the needle-leaved forest formation of the Rocky Mountain forest complex (Daubenmire, 1943), dominated by Douglas-fir (Pseudotsuga menziesii), quaking aspen (Populus tremuloides), Utah serviceberry (Amelanchier utahensis), pinyon pine (Pinus edulis), and Utah juniper (Juniperus osteosperma). The mosaic of plants within these major formations is the result of the differing ecological amplitudes of the dominant species and the alteration of climatic and edaphic gradients created by the diverse topography (Vories, 1974).

f. Abiotic Factors Affecting Plant Distribution - Vegetation development in the study area is primarily affected by its relationship to the following factors: the overall climatic regime, elevational gradient, topography, geology, and soil development.

Aspects of the climatic regime of critical importance to plants are distribution and amount of rainfall and snowfall, length of the growing season, maximum and minimum temperatures for a given area, and the frequency and velocity of wind. Available soil moisture is a major determining factor in plant distribution in this region. Temperature and wind affect the water evaporation rate from soil, which affects moisture availability to plants. Length of growing season, and maximum and minimum temperatures define limits within which plant species must be physiologically tolerant, and capable of reproduction. Wind is also important in defining snowdrift patterns which affect soil moisture.

An increase in elevation has the general effect of increasing precipitation, decreasing temperature and decreasing soil pH (Daubenmire, 1943). The elevation gradient is particularly evident in the study area, with a rise in elevation (approximately 2,500 feet) from the floor of the Piceance Basin to the summit of Cathedral Bluffs on the western perimeter of the Basin.

Variations in topography affect the amount of sunlight striking different slopes. The steepness of slope affects the angle with which the sun's rays strike the slope, and the direction of slope affects the duration that the sun shines on a slope. North-facing slopes are cooler and wetter than all other slope aspects, and south-facing slopes are drier and hotter. East and west-facing slopes are intermediate in temperature and moisture, with east-facing slopes being cooler and wetter than west-facing slopes. This is caused by the higher air temperatures prevalent during exposure to the afternoon sun. Because of these topographic modifications, plant associations from a lower, drier vegetation zone may be found on generally south-facing slopes in a higher zone, and plant associations from a higher, wetter zone may be found on the north-facing slops of a lower zone.

The geology of an area largely determines the types of soil that develop. Physical properties of soils determine aeration and moisture-holding capacity, and chemical properties are important in determining the avilability of nutrients and water to plants. Soil depth is important in determining moisture availability. Location of the water table affects the distribution of plant species, particularly along alluvial stream bottoms.

g. Biotic Factors Affecting Plant Distribution - The effects of wildlife and terrestrial invertebrates on vegetation composition and structure are developed in detail in other parts of this report and are mentioned here to indicate their importance in determining vegetation distribution and overall vegetation development.

At the lower elevations,shrub and tree species are selectively browsed by deer, resulting in a localized alteration of plant species composition and structure. Desirable plants, such as mountain mahogany, are heavily pruned, frequently releasing undesirable species from competition.

At the higher elevations within the pinyon-juniper woodland, the girdling of pinyon trunks by porcupines is common. Boring beetle infestations on pinyon pine, galls on Utah juniper, and tent caterpillars on Utah serviceberry and

mountain mahogany were observed to produce a localized loss of production and plant vigor.

The historic effects of man on the vegetation of the study area include the conversion of bottomland sage areas into hay meadows and the introduction of livestock and exotic plant species. The response of the native vegetation has been an alteration of community composition and structure due to the selective grazing pressures of livestock, and the invasion of exotic plant species on disturbed sites.

h. Vegetation Types

1) Aspen - The aspen type on the study area is characterized by the constant presence of aspen, and dense and diverse shrub and herbaceous strata, consisting primarily of serviceberry in the shrub stratum, and elk sedge (*Carex geyeri*) in the herbaceous stratum.

The type ranges in elevation from 8,140 ft to 8,560 ft on steep, north and east-facing slopes. The soils are generally deep sandy loams with large accumulations of organic matter.

The type is bordered at the higher elevations by the Douglas-fir type and at lower elevations by the mixed brush type. A few seedlings of Douglas-fir were found in areas where the aspen and Douglas-fir type bordered each other. Although aspen often precedes Douglas-fir in succession (Daubenmire, 1943), the low presence and reproductive success of Douglas fir in aspen stands indicated that most stands were not being replaced by Douglas-fir in the study area. The large number of aspen saplings and lack of mature trees in size classes greater than 24 cm (9.4 in) indicated a relatively high mortality rate and rapid turnover of individuals within the aspen population. This observation agrees with tree core samples collected by Vories (1974), which showed 67% of the aspen to be under 6 in. in diameter and less than 48 years old. Only 1% of the aspen trees were above 12 in. in diameter and over 64 years old. Also noted was the high incidence of heart rot in the larger size classes of quaking aspen.

Aspen reproduction by seeds is vary rare, and nearly all populations are clonal (sharing a common root system which sends up individual stems). Despite the short life span of individual trunks, the substantial resprouting observed in nearly all stands sampled indicates that most aspen stands within the study area are presently self-sustaining.

The diverse (14 species) shrub stratum is dominated by Saskatoon serviceberry (Amelanchier alnifolia) and Utah serviceberry. These species provide 19% and 14% cover, respectively. Common black chokecherry (Prunus virginiana, 12% cover) is also present. Mountain snowberry (Symphoricarpos oreophilus) is common as a low shrub and may dominate in more open stands, especially near the forest edge. Species such as Rocky Mountain maple (Acer glabrum) and Greene's mountain ash (Sorbus scopulina) were found in the moist sites. Phenology data indicate that the dominant shrub species, serviceberry and chokecherry, bloom in the spring, and produce ripening fruits by July. Common understory plants such as snowberry and Wood's rose (Rosa woodsii) bloomed in July, indicating a sustained period of flowering within the shrub stratum of this type, which may reflect a long period of available moisture.

Forbs characteristic of the summer growth included Canada violet (Viola canadensis), mountain thermopsis (Thermopsis montana), sweet root (Osmorhiza depauperata), and northern bedstraw (Galium boreale). Elk sedge achieves its highest cover values in the fall (6%) while most of the forb species become reduced in total cover. Low goldenrod (Solidago multiradiata) did not account for a large portion of the total cover (2% in July and 1% in September) but is strikingly noticeable in aspen stands of the study area because of its height.

The margins of the aspen stands were relatively open and grazed by livestock. The interior of the stands were steep and tangled by shrubs and fallen trees with no indication of livestock grazing.

2) Douglas-fir - The Douglas-fir type is characterized by the constant presence of Douglas-fir, and a dense and diverse shrub stratum. The herbaceous stratum is dominated by elk sedge. The Douglas-fir type is

restricted to higher elevations in the study area near the summit of Cathedral Bluffs, occurring on steep north and east-facing slopes. Douglas-fir dominates the tree stratum, providing nearly 100% relative cover, and occurs at densities of approximately 500 individuals per hectare. Uniform distribution of trees in the mature size class, and a very large percentage of all trees occurring in the smallest size class, indicate that Douglas-fir is actively reproducing, but also has a high seedling mortality.

The shrub stratum in the Douglas-fir type consists of two layers. The upper layer is dominated by Utah serviceberry, which occurs in large clones, and ranges in height to 3 m. The lower layer is dominated by mountain snowberry, which occurs at high densities and is usually less than 1 m in height. Together, the two species provide 42% of the total cover, and 46% of the total density. Both species were leafing out in May-June of 1975, and snowberry was flowering and serviceberry was forming fruits in July, 1975. Both species were recorded as vegetative in September, 1975.

Herbaceous species diversity and total cover is lower than in aspen stands at comparable elevations, indicating that Douglas-fir may exert a greater limiting influence on the herbaceous stratum than aspen. Elk sedge was the dominant species during all sampling periods, providing relatively constant cover of approximately 10% throughout the year. Maximum cover and species diversity occurred during July, when 23 species provided 23% total cover. Approximately 80% of the same species were present during sequential sampling periods. The dominant species, elk sedge, flowers in late spring shortly after snowmelt.

3) Mixed brush - The mixed brush type is characterized by the tall shrub life form of three species, Gambel oak, Utah serviceberry, and true mountain mahogany. The type occurs over an elevational range of 7,150 ft to 8,600 ft. The type occurs on a wide range of slopes from steep to gentle, and at all slope aspects. The best shrub development occurs on the steep north and east-facing slopes within the type. The soils associated with this type are shallow to moderately deep, well-drained sandy loams.

The mixed brush type intergrades with the aspen and Douglas-fir types on steep slopes at the upper elevations, and on the more gentle upland slopes and ridges it intergrades with the sagebrush type. At the lower elevations the mixed brush type graudally intergrades with the sagebrush type or may exist as islands on steep north-facing slopes within the pinyon-juniper type.

The shrub stratum shows a wide range of diversity with up to 20 species, and is divided into a tall shrub layer dominated by Utah serviceberry (52% relative cover) and a low shrub layer dominated by big sagebrush or mountain snowberry. Gambel oak increases in importance in the wetter stands and true mountain mahogany increases in importance on drier slopes or shale outcroppings.

Phenology data indicate that the dominant shrub species, Utah serviceberry and Gambel oak, flower during the spring, snowberry flowers during mid-summer, and composite species such as big sagebrush and rabbitbrush (Chrysothamnus sp.) flower in the fall.

In the spring, elk sedge was the only dominant species, providing over 2% cover out of the total cover of 5%. Total cover increased to 11% in July, and declined to 8% in September, 1975. In September 1975, elk sedge was the only species contributing over 1% cover.

The mixed brush type is represented by two plant associations in the study area. The Utah serviceberry-Gambel oak association is distinguished by the presence of Gambel oak and a dense shrub stratum. Ordination of transects sampled in this association by elevation and slope (Figure 3-7-7) indicates the narrow elevational range of this association, and its restriction to cool, steep slopes. Ferchau (1973) and Vories (1974) observed that Gambel oak is susceptible to late frosts and infrequent in its production of viable acorns in the study area. Gambel oak grows best in areas with considerable available water, intermediate temperatures, and moderate light (Christensen, 1949). It cannot tolerate intense grazing, strong winds, very warm or cold mean annual temperatures, or deep shade. It has a wide range of tolerance to soil types.

The clonal nature of both Utah serviceberry and Gambel oak as well as their dense cover (39% and 13% cover, respectively) produces an almost impenetrable thicket. Mountain snowberry is found in abundance in the openings between the taller shrubs and beneath serviceberry plants. Common black chokecherry and Saskatoon serviceberry are found in the wettest stands within the association. Big sagebrush (8% cover) is found commonly in more open stands and near the edges of the stands.

The herbaceous stratum is relatively well-developed (maximum of 26% cover), and is dominated by elk sedge.

The second mixed shrub association is the Utah serviceberry-mountain snowberry association. This association is distinguished by dispersed, large Utah serviceberry plants (26% cover) interspersed by mountain snowberry (12% cover). It is found on dry, low elevation slopes within the mixed brush type. Elevations average approximately 92 m (300 ft) less than elevations for the previous mixed brush association (Figure 3-7-6). The elevational ranges of the two associations nearly overlap in the study area. This association occurred on gentle slopes and at all slope aspects, although it was predominantly encountered on north and east-facing slopes.

Big sagebrush (8% cover) is common in the openings among the large Utah serviceberry plants. True mountain mahogany is found in the driest stands, usually on shale outcroppings. Other species indicative of dry sites include horsebrush (Tetradymia canescens), pinyon pine, Utah juniper and prickly pear (Opuntia polyacantha). The presence of pinyon pine and Utah juniper in the shrub stratum, in addition to the scarred stumps of these two tree species in some of the stands of this association, indicates successional relationships and competition between shrub species and pinyon and juniper.

The herbaceous layer is characterized largely by drought-resistant grasses and forbs. The plants tend to be well spaced with no clearly dominant or constant species. Five species showed greater than 1% cover: needle and thread (Stipa comata), sulfur eriogonum (Eriogonum umbellatum), sandberg bluegrass (Poa sandbergii), Nuttal's goldenweed (Haplopappus nuttallii), and Indian ricegrass (Oryzopsis hymenoides).

4) Pinyon-Juniper - The most extensive vegetation type in the Piceance Basin and the study area is dominated by pinyon pine and Utah juniper. In the Piceance Basin in the pinyon-juniper type is completely overlapped in elevation range (6,100 to 7,875 ft) by the sagebrush type (5,975 to 8,800 ft) (Vories, 1974). In the study area, the pinyon-juniper type was sampled over an elevational range of 6,500 to 7,660 ft.

Pinyon-juniper and sagebrush are segregated by the differing abilities of the dominant species to compete with each other under differing soil conditions. Sagebrush occupies the valleys, mesas, or gentle slopes where fine-textured, deep soils are prevalent. Pinyon-juniper occupies the ridges, canyons, or steep slopes where coarse rocky soils predominate. On soils intermediate in texture and depth there is a great deal of competition between sagebrush, pinyon pine, and juniper. The pinyon-juniper type also interacts with the mixed brush type, which occupies slopes where snow accumulates in winter within the elevation range of the pinyon-juniper type (Woodbury, 1947).

Within boundaries extending one mile from the Tract C-a border, 75% of the pinyon-juniper transects sampled during 1975 occupy shallow, well-drained soils formed from sandstone on steep to gentle upland slopes and ridges. Thirteen percent of the transects occurred on steep rock outcrop areas on south-facing slopes along major drainages. Eight percent of the transects occurred on soils originating from calcareous sandstone, and 4% occurred on moderately deep, well-drained soils formed from sandstone and windblown materials. The pinyon-juniper type was found on all slope aspects and showed no significant preference for any particular aspect.

The tree canopy of pinyon and Utah juniper in the study area is usually very open (21% total cover), with the individual trees well spaced (250 individuals/ha). The density of individual stands has been observed by Woodbury (1947) to increase with the increased available moisture at higher elevations. Woodbury also noted the tendency for juniper to be more prevalent on drier sites at lower elevations and pinyon to be more prevalent on wetter sites at higher elevations. The higher basal area for Utah juniper (23 m^2/ha) versus that for pinyon (14 m^2/ha) indicates the generally larger trunk size and probable greater

age of Utah juniper on the study area. It was shown by Vories (1974) that Utah juniper has a higher average age than pinyon within any given size class for the Piceance Basin.

Ordination of shrub and tree cover for the pinyon-juniper type against elevation indicates that the species and stratum components show a pattern often expressed in other studies. In a study of the synecology of the pinyon-juniper type, in the Great Basin and Colorado Plateau, West et al. (1975) found that tree cover of these two species increased to a maximum at about 2,200 m (approximately 7,260 ft) elevation, and then declined above this point. Maximum tree cover in the study area fell very near this value. Shrub stratum cover showed an inverse pattern, providing greatest cover at the lower and higher extremes of the range of the two dominant tree species. This study also indicates that big sagebrush increases in cover at the elevational extremes of the pinyon-juniper type, as indicated by the range of the pinyon-juniper/sagebrush association in this study.

The shrub stratum is diverse (17 species) but maintains a low average cover (11%). The shrub cover has been noted to increase with increasing available moisture and the removal of the tree canopy by fire or chaining. As indicated above, the shrub cover decreases with the increasing maturity of the tree species and reduction of available moisture by erosion. The most constant shrub within the type is big sagebrush. Seedlings and saplings of pinyon are common in the shrub stratum. Utah serviceberry is moderately frequent (40%) in the type and maintains a comparatively high cover (40%).

The herbaceous stratum is characterized by a high diversity (66 species), low total cover (2-6%) and the predominance of three grass species, slender wheatgrass (Agropyron trachycaulum), Sandberg bluegrass (Poa sandbergii) and Indian ricegrass (Oryzopsis hymenoides). Seasonal changes in cover are minimal and range from 2% in May-June to 6% in July, to 4% in September. No species contributed more than 0.5% cover in May-June. Three species, Agropyron trachycaulum, Poa sandbergii, and Oryzopsis hymenoides, contributed over 0.5% cover in July, while only Agropyron trachycaulum and Poa sandbergii contributed over 0.5% cover in September. The lack of herbaceous cover can be the result of several factors. The ability of pinyon and juniper litter to

inhibit germination (Jameson, 1961, 1966) is a partial explanation for the decrease in understory cover and diversity with the increasing age of a stand. The shade from the tree canopy is not usually effective in limiting understory development because of the limited canopy cover and the availability of reflected light (Shirely, 1945). Shade from the tree canopy may be beneficial to some species by reducing evaporation rates (Jameson, 1966). This was noted in the study area for Fremont goosefoot (Chenopodium fremontii) and several moss species. Competition for available moisture is thought to be more important in the distribution of understory species (Johnson, 1962; Arnold, 1964) than any other single factor in the pinyon-juniper type.

Three recognizable associations were distinguished for the study area pinyon-juniper type. They are the pinyon pine-Utah juniper-mixed brush association, the pinyon pine-Utah juniper-big sagebrush association, and the pinyon pine-Utah juniper-woodland association.

The pinyon pine-Utah juniper-mixed brush association has the highest average elevation of the three associations (7,140 ft). It is found primarily on cooler north and east-facing, relatively steep (averaging 11^{0}) slopes. The total tree cover for this association is lower than the average for the pinyon-juniper type as a whole (15 versus 21%). The high ratios of pinyon cover (11%), density (115 individuals/ha) and basal area (17 m^2/ha) to juniper cover (4%), density (58 individuals/ha) and basal area (6 m^2/ha) may be indicative of the relatively high moisture availability within this association.

The shrub stratum within this association has the greatest cover (20%) and density (5,867 individuals/ha) of any of the three associations. The most abundant shrub species are those typical of the mixed brush type, Utah serviceberry (8% cover), big sagebrush (7% cover), bitterbrush (1% cover) and true mountain mahogany (1% cover). Young pinyon plants are also frequent (90% frequency) in the shrub stratum.

The herbaceous stratum is not well developed and only supports 21 species within a total cover of 4%. Slender wheatgrass was the only species with more than 1% cover.

The pinyon pine-Utah juniper-big sagebrush association occurred at the lowest average elevation (6,310 ft) within the type. It is generally found on gentle upland slopes and ridges and shows no preference for a particular slope aspect. The comparatively high cover (11%), density (181 individuals/ha), and basal area (21 m^2/ha) of Utah juniper over the cover (9%), density (119 individuals/ha), and basal area (4 m^2/ha) of pinyon may be indicative of the relatively dry conditions that prevail at these sites.

The shrub stratum is dominated by big sagebrush with 7% cover. The remaining 13 shrub species contributed only 2% of the total 9% shrub cover and none of these species contributed more than 1% cover. The herbaceous stratum is the best developed of the three associations with 8% total cover. The six species with the greatest cover are all grasses typical of fairly dry sites, slender wheatgrass, prairie junegrass (Koeleria gracilis), needle and thread, western wheatgrass (Agropyron smithii), sandberg bluegrass, and Indian ricegrass.

The pinyon pine-Utah juniper woodland association represents the most mature stage of the pinyon-juniper type. This association's average elevation (6,900 ft) lies near the average elevation for the pinyon-juniper (6,940 ft). This association shows no preference for any particular slope aspect and is usually located on gentle (7^0) upland slopes and ridges. The slightly higher cover (14%) and basal area (39 m^2/ha) of Utah juniper appear to agree with Woodbury's (1947) suggestion that pinyon tends to replace juniper in mature stands. The high total cover (27%) and basal area (60 m^2/ha) of the tree stratum for this association is indicative of the relatively large size of the trees. The low total cover of the shrub (3%) and herbaceous (4%) strata is indicative of the monopolization of the habitat by the tree species despite the moderate tree canopy cover. No shrub species provided greater than 1% cover and only one herbaceous species (Sandberg bluegrass) exhibited more than 1% cover.

5) Sagebrush - The sagebrush type on the study area is characterized by the constant presence, high cover, and high density of big sagebrush in the shrub stratum and by a herbaceous stratum with high species diversity, but generally low cover. The sagebrush type occurs over a wider elevational (6,420-8,580 ft) range than any other type found on the study area (Figure 3-7-6), and generally occurs on gentle slopes. The sagebrush type occurred on deep alluvial soils in valley bottoms (Glendive series), on mixtures of moderately deep aeolian and residual soils (Rentsac and Piceance series), and on gently sloping upland (Yamac series) and shallow residual soils of the Rentsac series, located primarily on uplands and valley side-slopes.

On the study area the sagebrush type intergrades with the pinyon-juniper type at lower elevations along drainages, and on uplands along the ridges above the major drainages. Boundaries between sagebrush and pinyon-juniper types are frequently very distinct along transitions between alluvial bottomland sagebrush stands and pinyon-juniper stands occurring on steep shale outcrops. Transitions are often very gradual between the two types in areas where soil depth does not vary sharply. Big sagebrush is a frequent component of the understory in the pinyon-juniper type, and decreases in abundance with increasing density and cover of pinyon and Utah juniper. The sagebrush type also intergrades gradually with the mixed brush type on gentle upland slopes. Cover of Utah serviceberry increases with increasing elevation, and with transitions to cooler slope aspects.

The shrub stratum in this type contributes an average cover of 30%, and average densities of greater than 13,000 individuals/ha over the study area. Although 17 shrub species were encountered in this type, Artemisia tridentata generally provided 75% of the total cover, and 60% of the total density in the transects sampled. Frequent associates in the sagebrush type are green rabbitbrush (Chrysothamnus viscidiflorus) and Utah serviceberry. Phenology of common shrub species is divided between fall-blooming composite species (big sagebrush and green rabbitbrush), and spring and early summer-flowering species (Utah serviceberry and mountain snowberry).

The herbaceous stratum in this type contributes cover ranging from less than 10% during May-June to a maximum of 17% during July. The herbaceous stratum is characterized by a large number of species (100) which are heterogeneously distributed, without strong dominance by any one species. This heterogeneity reflects the wide elevational range of the type, which includes a number of microclimates within its boundaries. The dominant species over the type for all sampling periods, bluegrasses, ranged in cover from 1% in May-June 1975 to nearly 2% in July. There is a high persistence of species, with approximately 70% of all species shared in common between sequential sampling periods. Flowering of herbaceous species occurs primarily in early to late spring, when highest soil moisture levels are present. Almost no species were reproductively active during September, indicating high moisture stress near the soil surface in late summer. By contrast, big sagebrush and rabbitbrush were flowering during this period.

The sagebrush type is divided into four major associations, the upland and bottomland sagebrush, rabbitbrush, and greasewood associations. The rabbitbrush and greasewood associations are discussed in separate sections. The sagebrush associations (upland and bottomland sagebrush) are distinguished from each other by their occurrence on different soil types (alluvial versus residual), and by the taller stature and greater density and cover of bottomland sagebrush stands. Ordination of these two associations against elevation (Figures 3-7-13, 14) indicates that bottomland sagebrush has a restricted elevational range due to its occurrence at the bottom of drainages. Upland sagebrush has a much wider elevational range, occurring from nearly level areas on lower elevations of 84 Mesa up to high elevation east slopes just below the summit of Cathedral Bluffs. Cover of the bottomland sagebrush association does not show a strong response to increase in elevation. Cover in upland sagebrush transects increased slightly with elevation, but total cover was almost always less than cover in bottomland associations, regardless of elevation. These cover differences probably reflect a more reliable moisture supply in bottomland sagebrush stands. Herbaceous cover increased with elevation in the upland sagebrush association, but remained at a low level on all bottomland associations, reflecting either substantial competition from the shrubs, or intensive grazing.

The shrub stratum of the bottomland sagebrush association contributed a total cover of 43%, and a total density of 18,880 individuals/ha. Common species were big sagebrush, rubber rabbitbrush and mountain snowberry. Five percent cover was recorded for the herbaceous stratum during July. Western wheatgrass and Great Basin wild rye (Elymus cinereus) were the dominant herbaceous species.

The shrub stratum of the upland sagebrush association contributed a total cover of 30%, and total density of 9,345 individuals/ha. Other frequent species were green rabbitbrush, Utah serviceberry, and mountain snowberry. Fifty-one herbaceous species contributed 26% total cover during July, 1975. Tailcup lupine and sandberg bluegrass were the dominant species on the transects sampled.

6) Greasewood - The greasewood association occurs as small isolated patches within the bottomland sagebrush association. It is frequently an indicator of saline-sodic soils (Rickard, 1967), and occurs on deep, well-drained soils formed in alluvial deposits which usually have dependable ground-water. It shares dominance with big sagebrush which is an atypical situation for the two species. It is unclear whether on the study area this is due to disturbance or relative soil alkalinity.

Phenological data indicate that greasewood flowers during mid-summer, forming seeds during late summer and early fall. The highest density of sagebrush seedlings in greasewood stands indicate that greasewood may be a secondary successional element in bottomland sagebrush stands on the study area.

Seasonal variation in the herbaceous stratum shows that three annuals, annual stickseed (Lappula redowskii), fremont goosefoot, and pinnate Tansey Mustard (Descurrainia pinnata), were the most common species contributing over 50% of a total 12% cover during May-June of 1975. Western wheatgrass was the most common perennial species. Stands sampled in Yellow Creek have been seeded to crested wheatgrass (Agropyron desertorum).

By July the total herbaceous cover had increased from 12% cover in May-June to 29% cover. The greatest cover was again attained by annual species, summer

cypress (Kochia iranica) and lambs quarter goosefoot (Chenopodium album). These species showed a tendency to be clustered together by their high sociability values. Western wheatgrass was the most common perennial species.

Pehnological data indicate that most herbaceous species flower in spring when soil moisture is high after snowmelt.

7) Rabbitbrush - The rabbitbrush association sampled in the study area represents a successional stage in the bottomland sagebrush association. Most of the stands sampled in the study area are on abandoned agricultural lands or show evidence of the removal of big sagebrush by burning, defoliation or mechanical means. Burning of rabbitbrush normally kills it back to the soil surface only, and then it sprouts from the roots and increases in density by seedling establishment (Daubenmire, 1975). Rabbitbrush has been shown to dominate and periodically reestablish itself for at least 15 years. Reduced populations of rabbitbrush persist in communities where dominant big sagebrush plants are 40 to 50 years old (Young and Evans, 1974).

In the study area the elevational, topographic, and edaphic factors are essentially the same for rabbitbrush association as they are for the bottomland sagebrush association. It is found on floodplains and low terraces along the major drainages surrounded by the sagebrush type. Rabbitbrush is always the dominant species with 90 to 91% relative cover. In the study area, rabbitbrush forms flower buds during mid-summer, and flower in late summer and early fall.

The herbaceous stratum may be dominated by Great Basin wild rye (80% relative cover), which can completely conceal the shrubs by mid-summer by attaining a greater height. Young stands of rabbitbrush were more likely to have a herbaceous understory of annuals such as Fremont goosefoot.

Herbaceous species were found flowering during May-June, and disseminating seeds by July. Some reproductive activity was still evident in September, unlike the majority of bottomland sagebrush and greasewood transects sampled, where nearly all species were vegetative, dead, or dormant.

8) Bald - The bald type is characterized by the absence of developed tree and shrub strata, and a diverse herbaceous cover consisting of perennial forbs and grasses. The term "bald" is derived from the "heath bald" communities found on the summits of some peaks in the Appalachian Mountains (Whittaker, 1956). Although not analagous to the Appalachian Balds, the term "bald" adequately describes the oepn bare slopes surrounded by communities dominated by taller shrubs or trees, and also implies a harshness which characterizes those windswept areas that occur along the summit of Cathedral Bluffs, and on exposed ridges at lower elevations. The bald type ranges in elevation from 7230 to 8550 ft, and occurs almost exclusively (80%) on west slope aspects facing the prevailing wind. Transects were sampled primarily on the Rentsac soil series. Field observations indicate that soils were frequently extremely shallow and rocky.

Shrub species occur sparingly on the bald type (1-5% cover), and are usually of very low stature. Utah serviceberry provided the most cover, but was generally restricted to more protected sites. Low stature shrubs characteristic of this type were green rabbitbrush and horsebrush.

The diverse (60 species) herbaceous stratum consists of low grass and forb species that frequently form a carpet-like mat that assists in reducing dessication by strong winds. Total cover ranges from less than 10% in May-June to greater than 20% in July. Dominance is usually shared by several species. Species contributing greatest cover were slender wheatgrass, prairie junegrass, tufted milkvetch (Astragalus spatulatus), and mat penstemon (Penstemon caespitosus). Many of the species encountered in the bald type were also encountered in the herbaceous stratum of the sagebrush and pinyon-juniper types, indicating a compositional continuity with these communities.

During the May-June, 1975 sampling period, nearly all species were in a vegetative state, over half the species were flowering or forming seeds in July, and nearly all species declined to a vegetative state in September.

9) Shadscale - The shadscale type occurs over a short elevational range (6,460-6,810 ft) in narrow bands on steep, generally south-

facing slopes adjacent to major drainages within the study area. It occurs on rock outcrops or very shallow soils derived from sandstone cliffs or platy siltstone outcrops.

Total shrub cover is low (14 to 16%). Shadscale shares dominance with three shrubs from the sagebrush type, big sagebrush, green rabbitbrush, and rubber rabbitbrush (C. nauseosus), indicating its close relationship to the sagebrush type.

Herbaceous cover was extremely low in May-June, totaling less than 1%. In July, it had increased in total cover to just under 3%, with eriogonum (Eriogonum lonchophyllum) measuring just over 1% cover. In September the cover values changed very little, decreasing in total cover by less than 0.5%. Indian ricegrass showed a high constancy in all sampling periods.

10) Riparian - The riparian type in the study area consists of three different types of environments: small springs in open alluvial bottomlands that have been converted to pastureland (e.g., Stake Springs, T2S R99W S14) occupied by common pasture weeds; hillside springs and seeps along the bottom of steep draws (e.g., Cottonwood Spring, T2S R99W S19) which are not heavily grazed and contain several unusual species for the Piceance Basin; and drainageways of intermittent streams that contain species characteristic of the bottomland sagebrush association.

Tree species were not frequent in this type. Aspen appeared on one transect sampled at a high elevation. A few large individuals of narrowleaf cottonwood (Populus angustifolia) were observed at Cottonwood Spring.

Dominants in the shrub stratum, big sagebrush and rubber rabbitbrush are found along the drainageways of intermittent streams. In a few isolated areas (Cottonwood Spring, Duck Creek), more characteristic riparian species were found: water birch (Betula fontinalis), willow (Salix exigua and Salix interior), and red osier dogwood (Swida sericea). In wet pastures, shrubs are largely absent except for rubber rabbitbrush, which occurs around the fringes. Total shrub cover for the type ranges from a low of 2% cover on disturbed pasture sites to 25% cover for transects sampled in hillside springs and along intermittent streams.

Permanent herbaceous quadrats are located in wet pasture sites. As a result, the high total cover (50 to 80%) reflects the very moist growing conditions. Quackgrass (Agropyron repens), Kentucky bluegrass (Poa pratensis) and common dandelion (Taraxacum officinale) were common constituents of wet pastures. Several unusual herbaceous species were collected on moist sites in the vicinity of Cottonwood Springs. These include an endemic columbine (Aquilegia barnebyi), and alpine pyrola (Pyrola asarifolia), a species restricted to cool, damp sites. Fowl mannagrass (Glyceria striata) was found only in areas of permanent running water.

Phenology of several species occurring in pastureland areas could not be evaluated because of heavy grazing. Species in streamside habitats were frequently found to be flowering and forming seeds on the same plant, possibly indicating a longer flowering season in these areas with greater available moisture.

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Figures and Tables for the

Phytosociological Studies Section

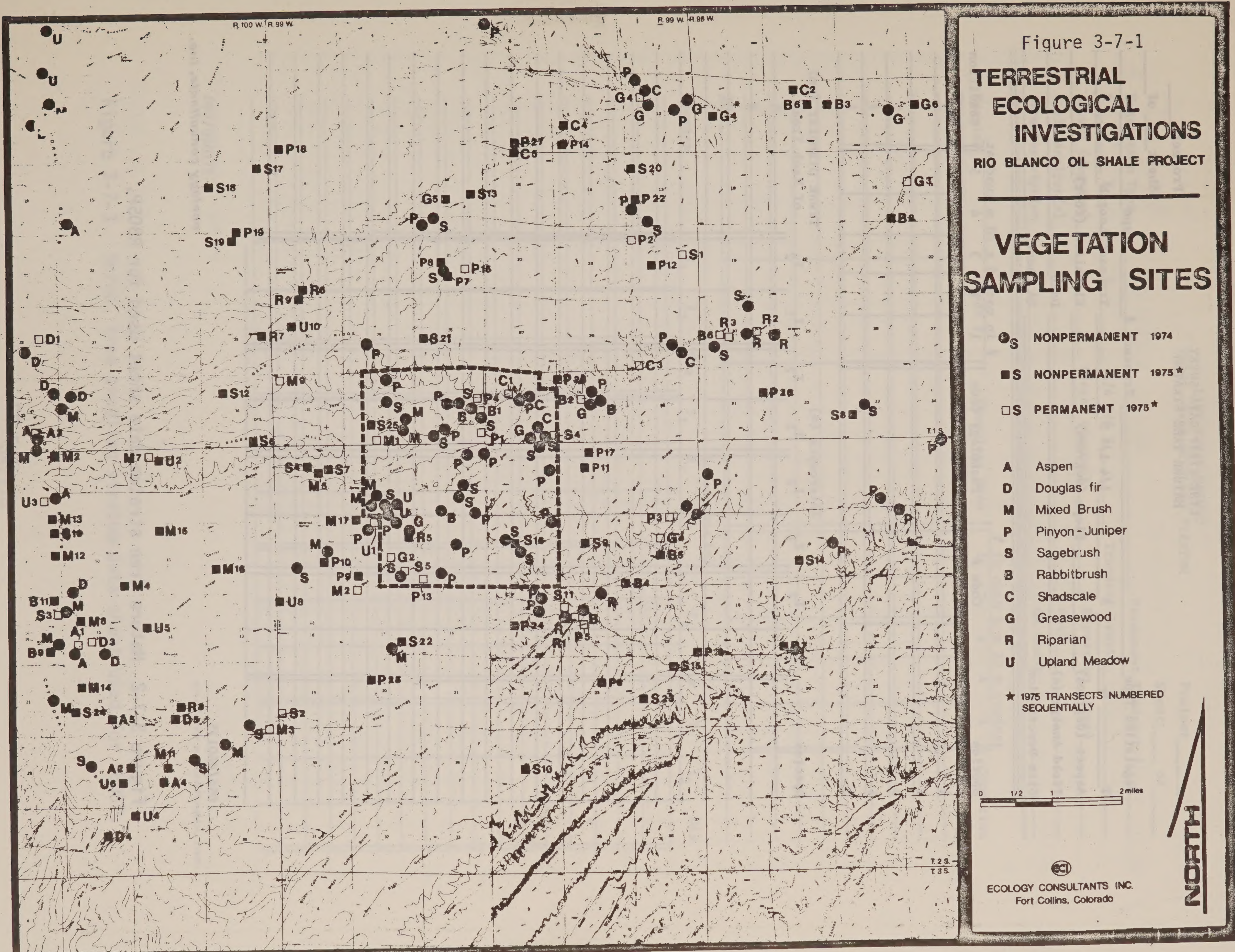
Figure 3-7-1
TERRESTRIAL ECOLOGICAL INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
VEGETATION SAMPLING SITES
S NONPERMANENT 1974
S NONPERMANENT 1975*
S PERMANENT 1975*
A Aspen
D Douglas fir
M Mixed Brush
P Pinyon - Juniper
S Sagebrush
B Rabbitbrush
C Shadscale
G Greasewood
R Riparian
U Upland Meadow
* 1975 TRANSECTS NUMBERED SEQUENTIALLY
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R.100 W. R.99 W.
R.99 W. R.98 W.
T.1 S.
T.2 S.
T.3 S.

LINE-STRIP DATA SHEET
MATURE TREE STRATUM

Project______
Sheet____ of_____

Vegetation Type________________________ Transect #________ Type________________

T__________ R__________ S____________ 1/4 1/4 S____________ Transect Length________________

Aspect (degrees)______________ Slope (degrees)____________ Elevation (feet)________________

Field Analyst(s)________________________________ Date________________

Site Description________________________________ QA Check________________

Species	Code #	Phenology Code	# in each 6 x 20 m quadrat 1	2	3	4	5	Condition
1								
2								
3								
4								
5								

Species	Intercepts (m) I_1	I_2	I_1	I_2	I_1	I_2	I_1	I_2	Trunk Diameter (cm) of Each Tree

096/060175

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Figure 3-7-2 Mature tree stratum data sheet used for RBOSP.

LINE-STRIP METHOD
SHRUB, TREE SEEDLING STRATUM

Project______

Sheet_____ of______

Vegetation Type______________________________ Permanent Transcect #________

T________ R________ S________ 1/4 1/4 S________ Transect Length________________

Aspect (degrees)______________ Slope (degree)____________ Elevation (feet)____________

Field Analyst(s)______________________________ Date________________

Site Description______________________________ QA Check________________

Species	Code #	Phenology Code	# in each 6 x 20 m quadrat 1	2	3	4	5	Condition
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Intercepts (m)

Species	I_1	I_2	Dia	I_1	I_2	Dia	I_1	I_2	Dia	I_1	I_2	Dia

097/060175-1

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Figure 3-7-3 Shrub, tree seedling stratum data sheet used for RBOSP.

LINE-STRIP DATA SHEET
SHRUB, TREE SEEDLING STRATUM

Project________

Sheet_____ of______

Vegetation Type________________________ Permanent Transect #__________ Date__________

Species	I_1	I_2	Dia	I_1	I_2	Dia	I_1	I_2	Dia	I_1	I_2	Dia

097/060175-2

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Figure 3-7-4. Shrub, tree seedling stratum data sheet used for RBOSP. (second page)

QUADRAT DATA SHEET
HERBACEOUS STRATUM

Project________

Sheet_____ of ______

Vegetation Type______________________________ Transect #_______ Type________________

T________ R________ S________ 1/4 1/4 S__________ Quadrat Size____________________

Aspect (degrees)__________ Slope (degrees)__________ Elevation (feet)______________

Field Analyst(s)______________________________ Date______________________

Site Description______________________________ QA Check__________________

Species	Code #	Phenology Code	Quadrat Number 1		2		3		4		5		6		7		8		9		10	
			#	C	#	C	#	C	#	C	#	C	#	C	#	C	#	C	#	C	#	C

099/060175-1

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Figure 3-7-5 Herbaceous stratum data sheet used for RBOSP.

Figure 3-7-6 Elevation range and mean of vegetation types and associations occurring on the Tract C-a Study area for RBOSP

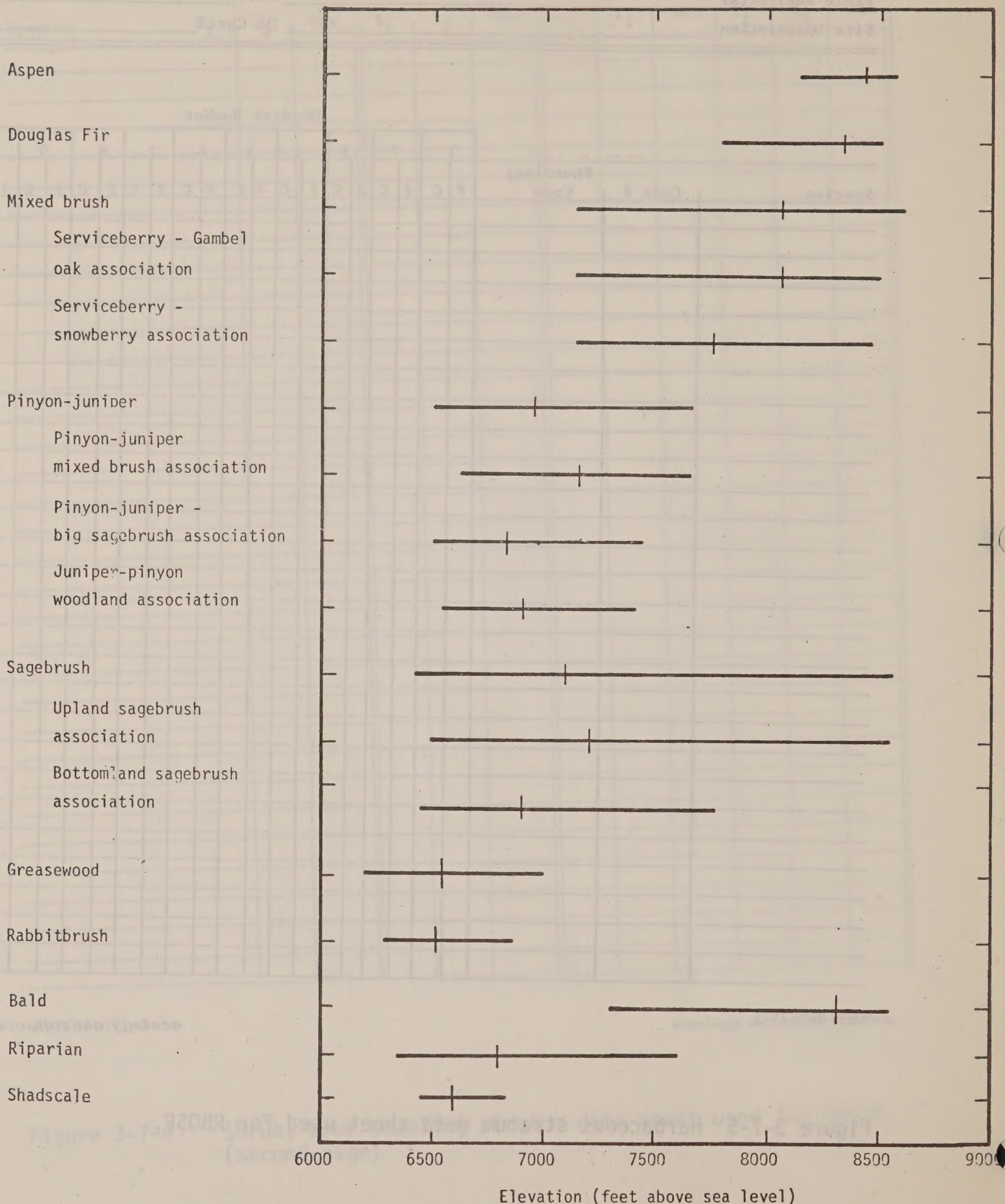


Figure 3-7-7 . Cover (m^2 per hectare) of the shrub stratum in transects sampled in the mixed brush type in relation to elevation, slope aspect, slope inclination, and association classification for RBOSP.

■ Shrub cover, serviceberry-Gambel oak association

□ Shrub cover, serviceberry-snowberry association

Note: Presence of a line projecting from a symbol indicates a slope >5° in the transects sampled. Orientation of the line indicates slope aspect.

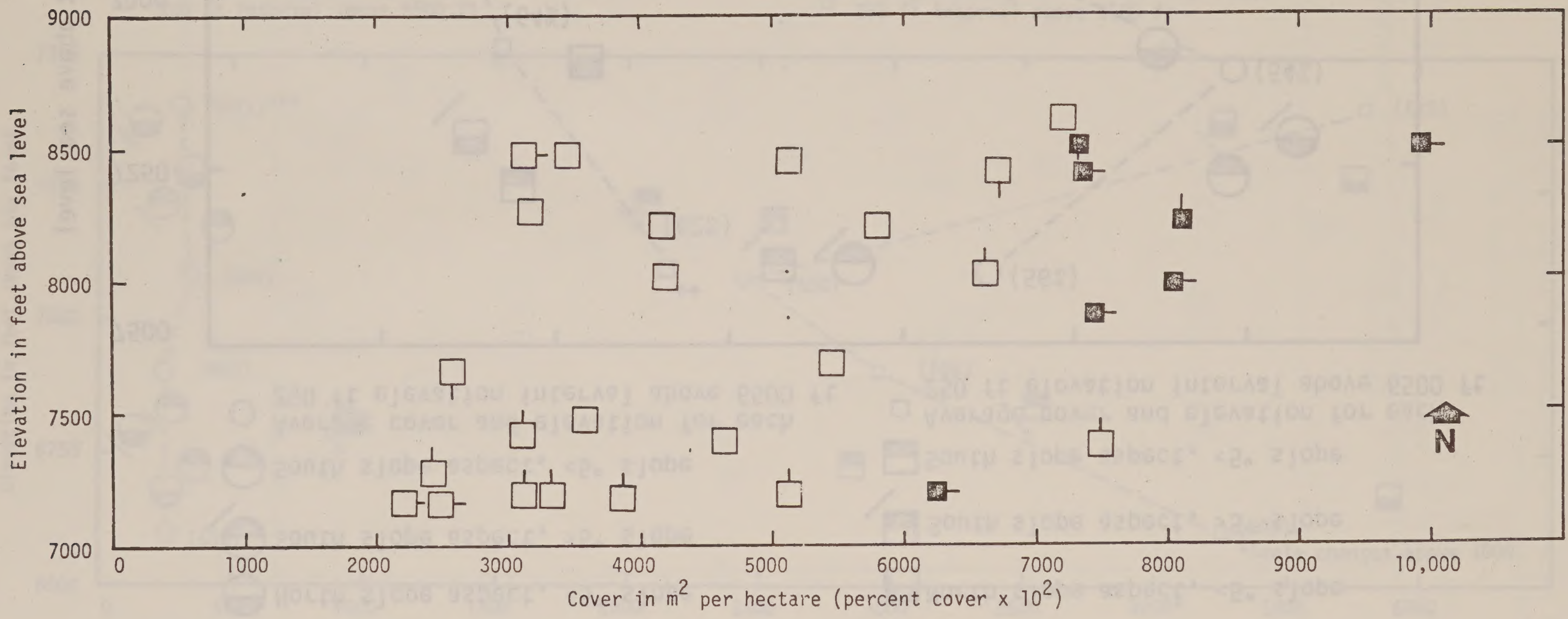
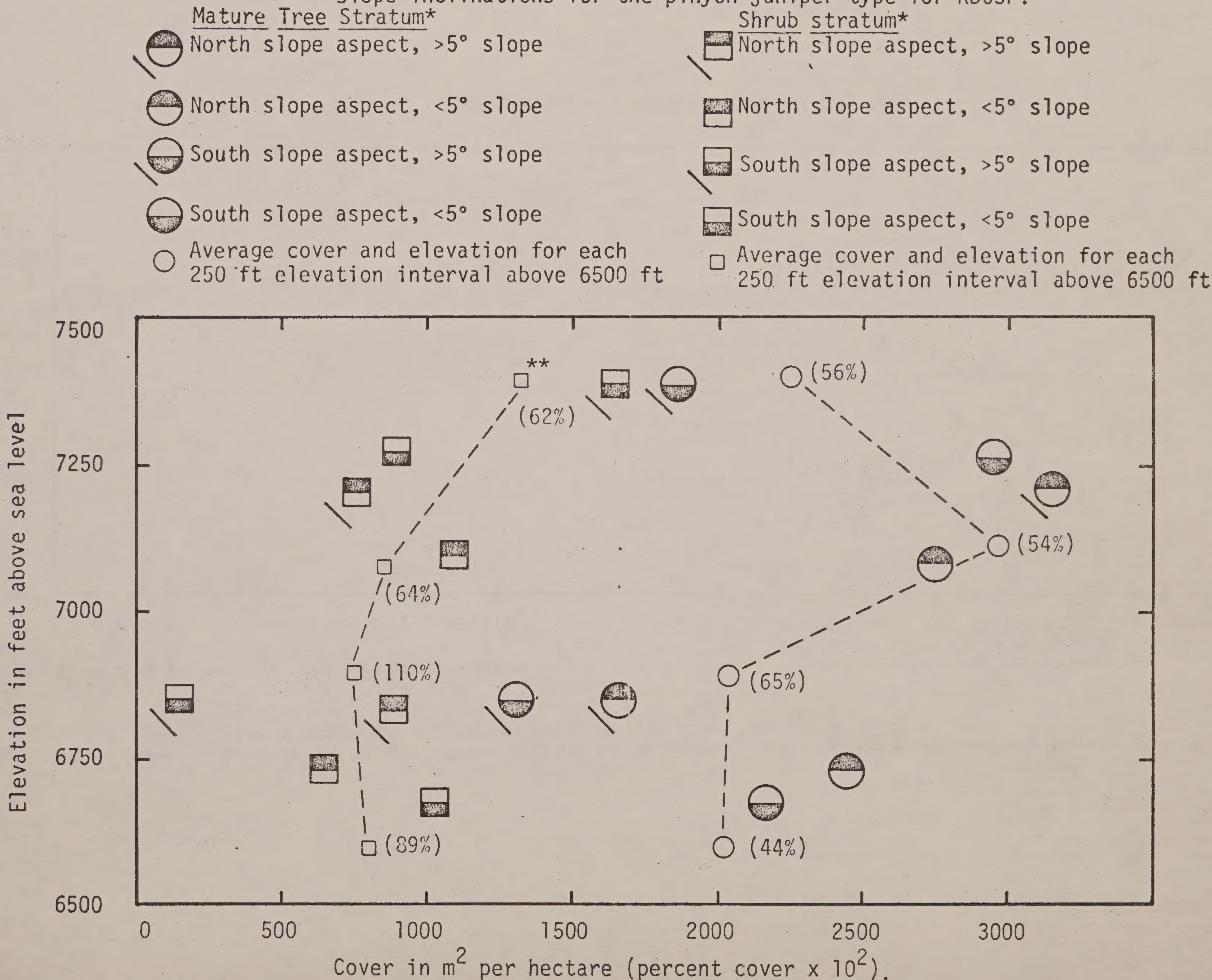


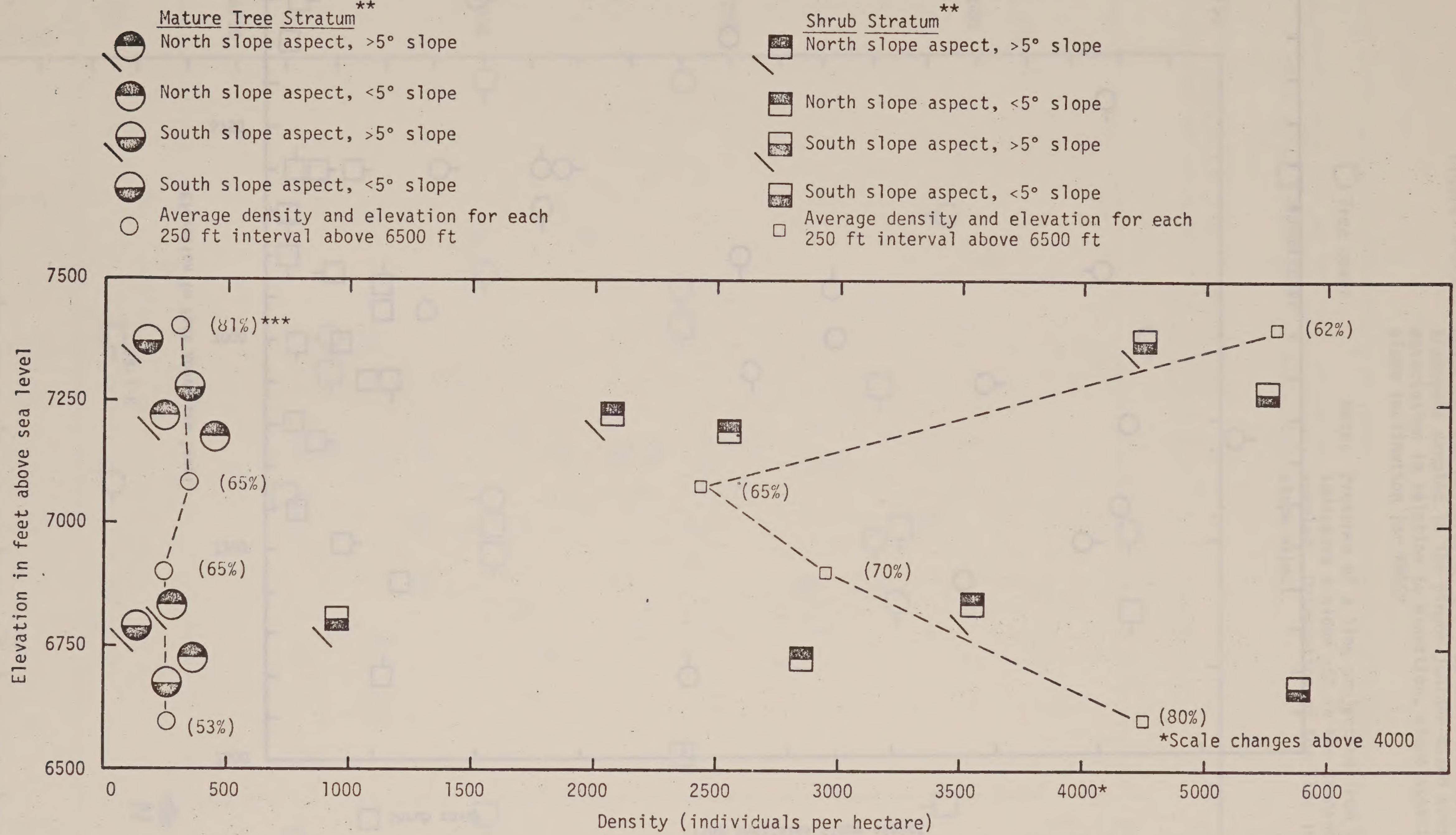
Figure 3-7-8 . Comparison of mature tree and shrub strata cover (m^2 per hectare) in transects sampled at different elevations, slope aspects, and slope inclinations for the pinyon-juniper type for RBOSP.



*Average cover for transects occurring within two 500 ft elevation intervals (6500-7000, 7000-75000).

**Standard deviation

Figure 3-7-9. Comparison of mature tree and shrub strata densities (individuals per hectare) in transects sampled at different elevations, slope aspects, and slope inclinations for the pinyon-juniper type for RBOSP.



**Average density for transects occurring within two 500 ft elevation intervals (6500-7000, 7000-7500).

***$\frac{\text{Standard deviation}}{\text{mean}} \times 100$

Figure 3-7-10 . Cover (m^2 per hectare) of the tree and shrub strata in transects sampled in the juniper-pinyon woodland association in relation to elevation, slope aspect, and slope inclination for RBOSP.

Note: Presence of a line projecting from a symbol indicates a slope >5° in the transects sampled. Orientation of the line indicates slope aspect.

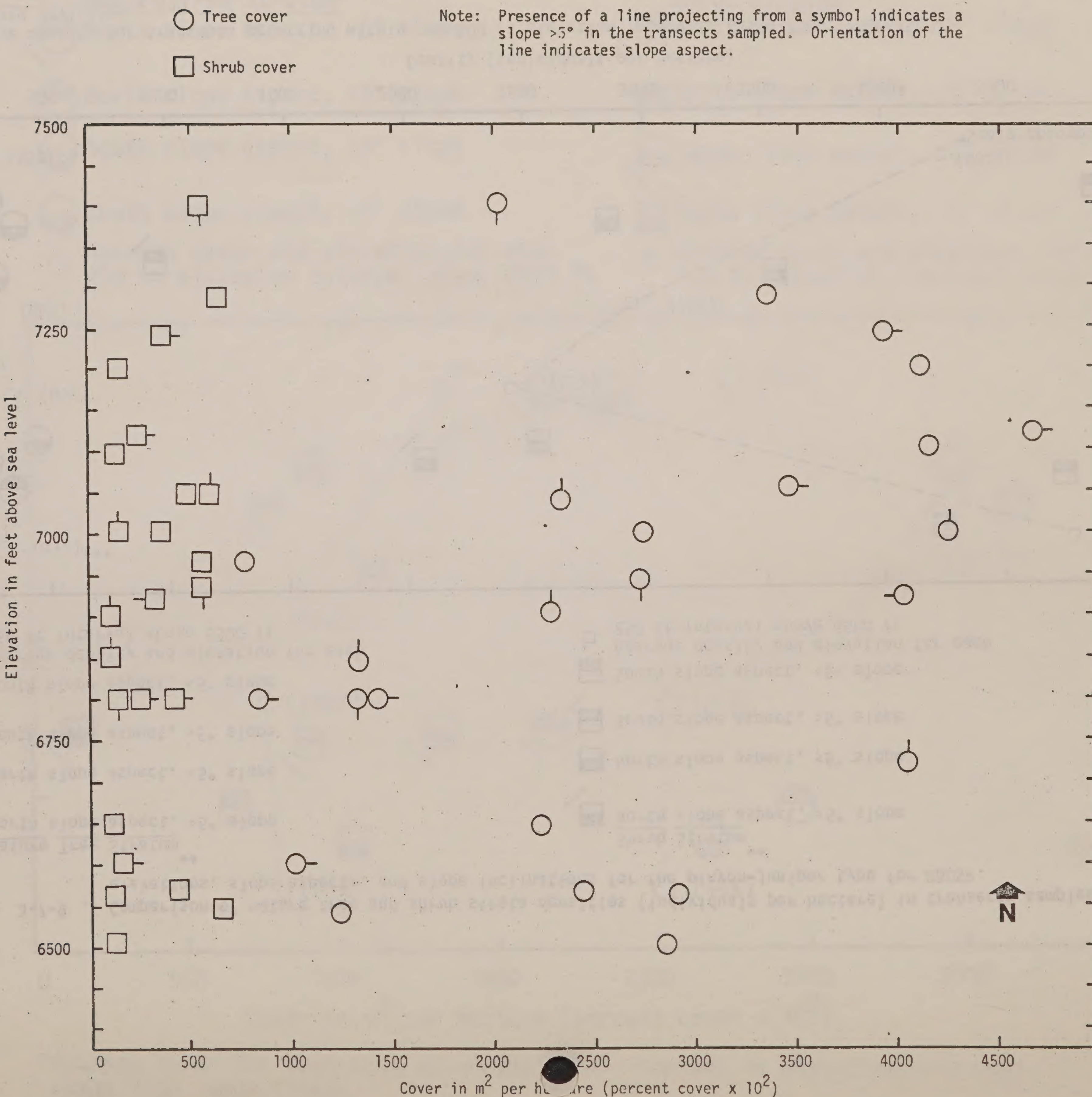


Figure 3-7-11. Cover (m^2 per hectare) of the tree and shrub strata in transects sampled in the pinyon-juniper-mixed brush association in relation to elevation, slope aspect, and slope inclination for RBOSP.

○ Tree cover

□ Shrub cover

Note: Presence of a line projecting from a symbol indicates a slope >5° in the transects sampled. Orientation of the line indicates slope aspect.

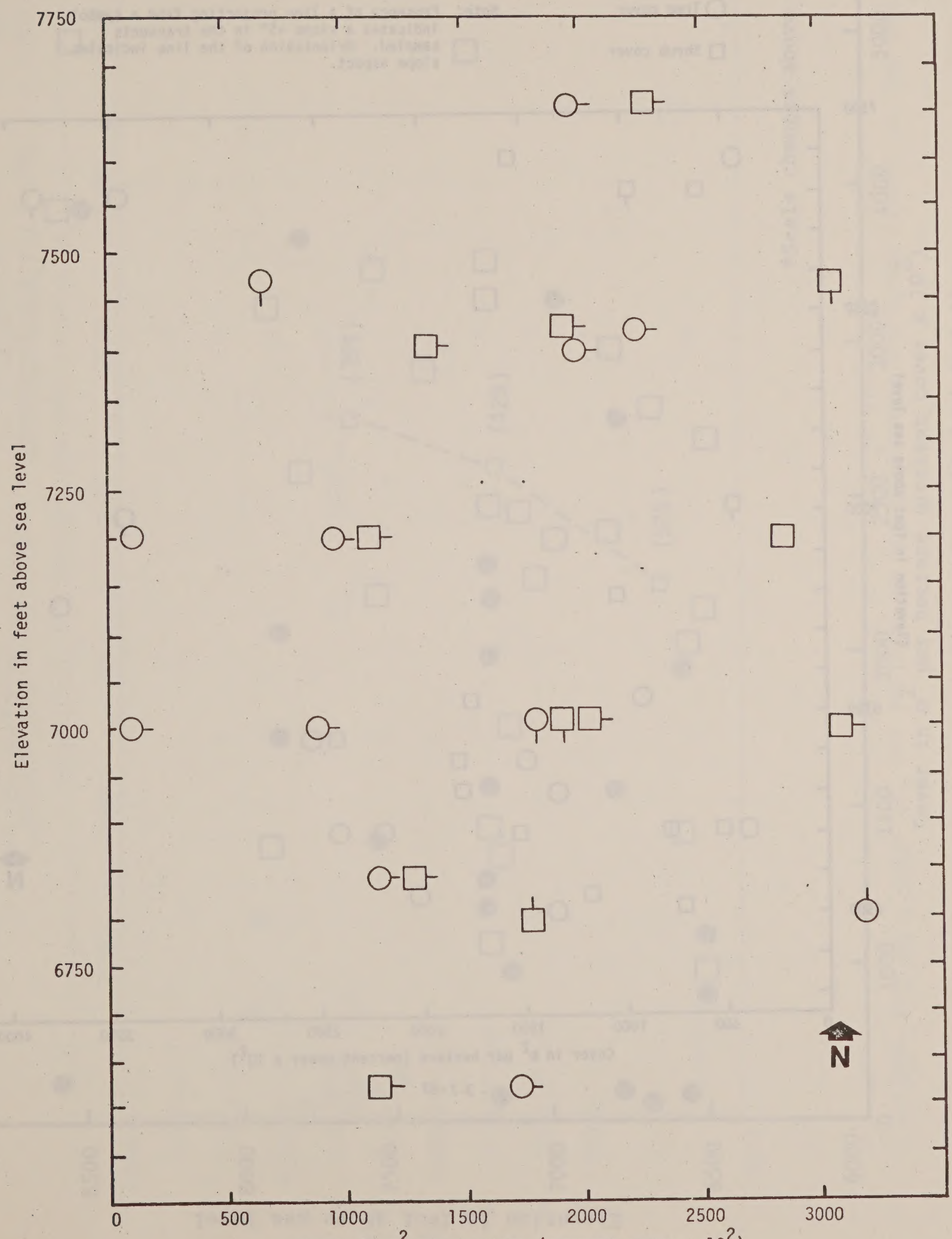


Figure 3-7-12 . Cover (m^2 per hectare) of the tree and shrub strata in transects sampled in the pinyon-juniper-sagebrush association in relation to elevation, slope aspect, and slope inclination for RBOSP.

○ Tree cover

□ Shrub cover

Note: Presence of a line projecting from a symbol indicates a slope >5° in the transects sampled. Orientation of the line indicates slope aspect.

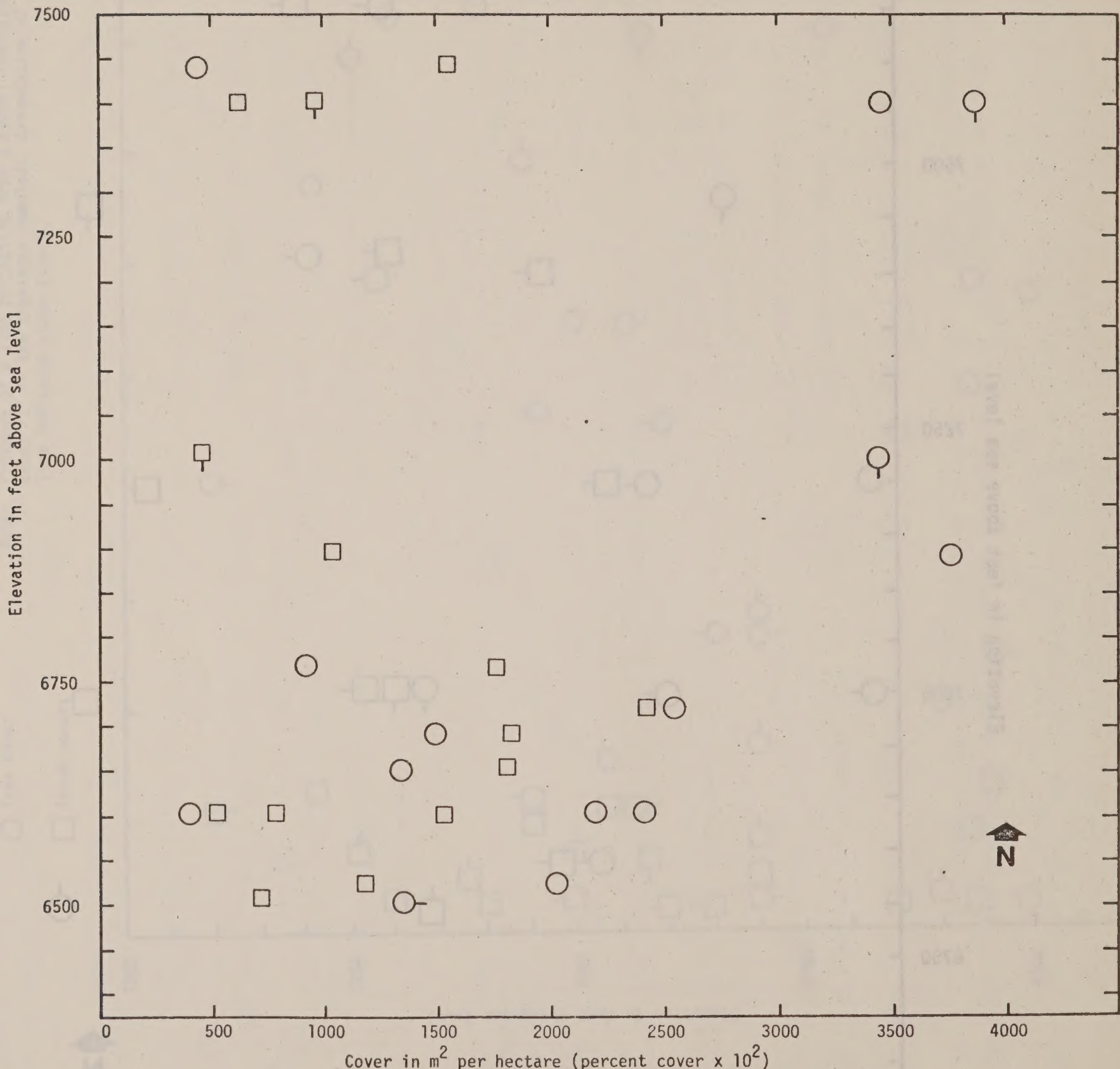
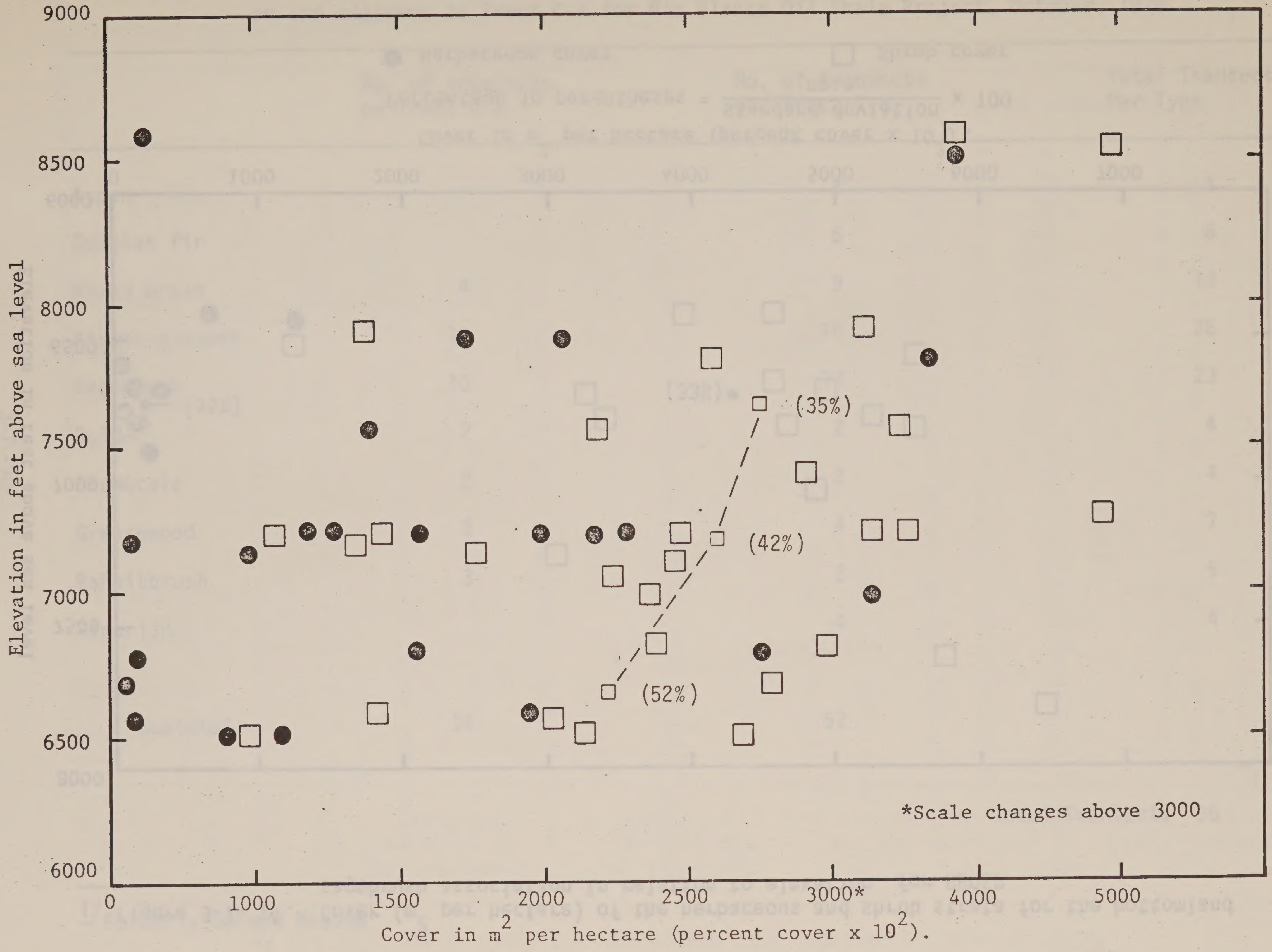


Figure 3-7-13. Cover (m^2 per hectare) of the herbaceous and shrub strata for the upland sagebrush association in relation to elevation for RBOSP



Percentage in parentheses = $\frac{\text{standard deviation}}{\text{mean}} \times 100$

● Herbaceous cover □ Shrub cover □ Average shrub cover per 500 ft interval

Figure 3-7-14. Cover (m^2 per hectare) of the herbaceous and shrub strata for the bottomland sagebrush association in relation to elevation for RBOSP

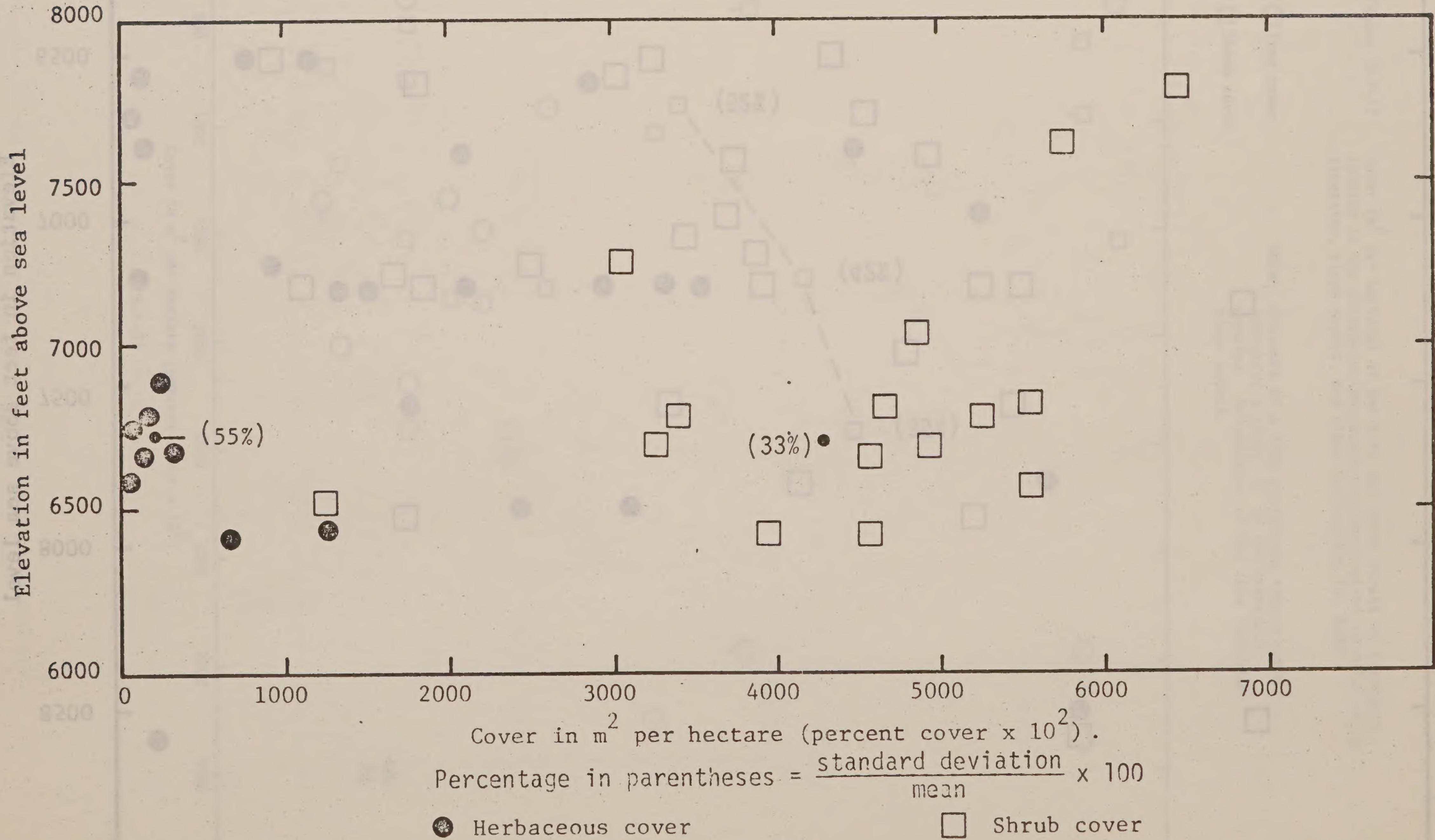


Table 3-7-1 Numerical distribution of sampling transects (60 m x 6 m) in the major vegetation types on and adjacent to Tract C-a for Rio Blanco Oil Shale Project, October, 1974

	No. of transects on Tract C-a	No. of transects off Tract C-a	Total Transects Per Type
Aspen		4	4
Douglas fir		6	6
Mixed brush	4	9	13
Pinyon-juniper	10	16	26
Sagebrush	10	13	23
Bald[1/]	2	2	4
Shadscale	2	2	4
Greasewood	3	4	7
Rabbitbrush	3	2	5
Riparian		4	4
Subtotal	34	62	
		Total Transects	96

1/ Formerly Upland Meadow

Table 3-7- 2 Numerical distribution of sampling transects (100 m x 6 m) in the major vegetation types on and adjacent to Tract C-a during the 1975 sampling periods for RBOSP

	No. Permanent Transects On Tract C-a	No. Permanent Transects Off Tract C-a	No. Non-permanent Transects	Total Transects Per Type
Aspen		2	3	5
Douglas fir		2	3	5
Mixed brush	1	4	12	17
Pinyon-juniper	2	5	18	25
Sagebrush	2	5	18	25
Bald [1/]	1	1	9	11
Shadscale	1	1	3	5
Greasewood	1	2	3	6
Rabbitbrush	1	1	6	8
Riparian		3	6	9
Subtotal	9	26	81	
			Total Transects	116

[1/] Formerly Upland Meadow

Table 3-7-3 Species of plants observed to date in the vicinity of Tract C-a for RBOSP[1]

Abbrev.	Species
	TREES
Juos[1/]	*Juniperus osteosperma* (Torr.) Little;[2/] (Pinaceae),[3/] Phan,[4/] Utah juniper, (V) 5/
Pied	*Pinus edulis* Engelm.; (Pinaceae), Phan, pinyon pine
Poan	*Populus angustifolia* James; (Salicaceae), Phan, narrowleaf cottonwood, (V)
Potr	*Populus tremuloides* Michx.; (Salicaceae), Phan, quaking aspen
Psme	*Pseudotsuga menziesii* (Mirbel) Franco; (Pinaceae), Phan, Douglas fir
	SHRUBS
Acgl	*Acer glabrum* Torr.; (Aceraceae), Phan, Rocky Mountain maple, (V)
AMELA	*Amelanchier* sp.
Amal	*Amelanchier alnifolia* Nutt.; (Rosaceae), Phan, Saskatoon serviceberry, (V)
Amut	*Amelanchier utahensis* Koehne; (Rosaceae), Phan, Utah serviceberry, (V)
Arfr	*Artemisia frigida* Willd.; (Compositae), Cham, fringed sagebrush, (V)
Artr	*Artemisia tridentata* Nutt.; (Compositae), Phan, Cham, big sagebrush, (V)
Atca	*Atriplex canescens* (Pursh) Nutt.; (Chenopodiaceae) Cham, fourwing saltbrush, (V)
Atco	*Atriplex confertifolia* (Torr. & Fremont) S. Wats.; (Chenopodiaceae), Cham, shadscale, (V)
	Berberis repens; See *Mahonia repens*

* Footnotes listed at end of species list.

Table 3-7-3 (Continued)

Abbrev.	Species
	SHRUBS (Cont.)
Befo	Betula fontinalis Sarg.; (Betulaceae), Phan, water birch, (V)
	Betula occidentalis; See Betula fontinalis
Cema	Ceanothus martini M.E. Jones; (Rhamnaceae), Cham, Martin ceanothus, (V)
Cemo	Cercocarpus montanus Raf.; (Rosaceae), Phan, true mountain mahogany, (V)
CHRYS	Chrysothamnus sp.
Chde	Chrysothamnus depressus Nutt. (Compositae), Cham, dwarf rabbitbrush
Chna	Chrysothamnus nauseosus (Pall.) Britt, in Britt & Brown (Compositae), Phan, rubber rabbitbrusn, (V)
Chvi	Chrysothamnus viscidiflorus (Hook.) Nutt, (Compositae) Cham, Douglas rabbitbrush, (V)
	Cornus stolonifera; See Swida sericea
Epvi	Ephedra viridis Coville; (Ephedraceae), Cham, green ephedra
Eula	Eurotia lanata (Pursh) Moquin; (Chenopodiaceae), Cham, common winterfat, (V)
Gusa	Gutierrezia sarothrae (Pursh) Britt. & Rusby; (Compositae), Cham, broom snakeweed
Hodu	Holodiscus dumosus (Nutt.) Heller; (Rosaceae), Cham, bush ocean-spray, (V)
Mare	Mahonia repens (Lindl.) G. Don; (Berberidaceae), Cham, creeping barberry, (V)
Opfr	Opuntia fragilis (Nutt.) Haw.; (Cactaceae), Succ, brittle pricklypear
Oppo	Opuntia polyacantha Haw.; (Cactaceae), Succ, plains pricklypear

Abbrev.	Species
	SHRUBS (Cont.)
Pamy	Pachystima myrsinites (Pursh) Raf.; (Celastraceae), Cham, myrtle pachystima, (V)
Puvim	Prunus virginiana var. melanocarpa (A. Nels.) Sarg.; (Rosaceae), Phan, black common chokecherry
Putr	Purshia tridentata (Pursh) D.C.; (Rosaceae), Cham, antelope bitterbrush, (V)
Quga	Quercus gambelii Nutt.; (Fagaceae), Phan, Gambel oak, (V)
RIBES	Ribes sp.
Riau	Ribes aureum Pursh; (Saxifragaceae), Cham, golden current, (V)
Rice	Ribes cereum Dougl.; (Saxifragaceae), Cham, wax current, (V)
Riin	Ribes inerme Rydb.; (Saxifragaceae), Cham, whitestem gooseberry, (V)
ROSA	Rosa sp.
Rowo	Rosa woodsii Lindl.; (Rosaceae), Cham, Wood's rose
Saex	Salix exigua Nutt.; (Salicaceae), Cham, willow, (V)
Sain	Salix interior Rowlee; (Salicaceae), Cham, willow, (V)
Saco	Sambucus coerulea Raf.; (Caprifoliaceae), Cham, blueberry elder, (V)
Save	Sarcobatus vermiculatus (Hook.) Torr.; (Chenopodiaceae), Cham, black greasewood, (V)
Sosc	Sorbus scopulina Greene; (Rosaceae), Cham, Greenes mountain-ash, (V)
Swse	Swida sericea (L.) Holub; (Cornaceae), Cham, redosier dogwood, (V)

Abbrev.	Species
	SHRUBS (Cont.)
Syor	Symphoricarpos oreophilus A. Gray; (Caprifoliaceae), Cham, mountain snowberry (V)
Teca	Tetradymia canescens D.C.; (Compositae), Cham, gray horsebrush, (V)
	HERBACEOUS (NON-GRASSLIKE)
Acla	Achillea lanulosa Nutt.; (Compositae) Hemi, western yarrow, (N) 6/ (V)
Agur	Agastache urticifolia Kuntze; (Labiatae), Hemi, nettleleaf giant-hyssop, (N) (V)
AGOSE	Agoseris sp.
Agau	Agoseris aurantiaca (Hook.) Greene; (Compositae) Hemi, orange agoseris, (N) (V)
Aggl	Agoseris glauca (Pursh) Raf.; (Compositae), Hemi, pale agoseris, (N) (V)
Alte 2	Allium textile Nels. & Macbr.; (Liliaceae), Cryp, textile onion, (N) (V)
AMBRO	Ambrosia sp. (L.); (Compositae) Ther, ragweed, (N)
Anse	Androsace septentrionalis L.; (Primulaceae), Ther, rock-jasmine, (N) (V)
ANGEL	Angelica sp.
Anam	Angelica ampla A. Nels; (Umbelliferae), Hemi, Angelica, (N) (V)
Anpi	Angelica pinnata S. Wats; (Umbelliferae), Hemi, small-leaf angelica, (N) (V)
ANTEN	Antennaria sp.
Anmi	Antennaria microphylla Rydb.; (Compositae), dioecious, Hemi, rose pussytoes (N) (V)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Anpu	Antennaria pulcherrima (Hook.) Green; (Compositae), dioecious, Hemi, showy pussytoes, (N) (V)
Anro	Antennaria rosea Green; (Compositae), dioecious, Hemi, rose pussytoes (N) (V)
Aqba	Aquilegia barnebyi Munz; (Ranunculaceae), Hemi, columbine, (Rare--endemic to Green River shale deposits), (N) (V)
Aqca	Aquilegia caerulea James; (Ranunculaceae), Hemi, Colorado columbine, (Protected by Colorado State Law) (N) (V)
ARABI	Arabis sp.
Ardi 3	Arabis divaricarpa A. Nels.; (Cruciferae), Hemi, rockcress, (N) (V)
Ardr	Arabis drummondi A. Gray; (Cruciferae), Hemi, Drummond rockcress, (N) (V)
Arfe 4	Arabis fendleri (Wats.) Greene; (Cruciferae), Hemi, Fendler rockcress, (N) (V)
Arfes	Arabis fendleri var. spatifolia (Rydb.) Rollins; (Cruciferae), Hemi, rockcress, (N) (V)
ARENA	Arenaria sp.
Area	Arenaria eastwoodiae Rydb.; (Caryophyllaceae), Hemi, sandwort, (N) (V)
Arfe	Arenaria fendleri A. Gray; (Caryophyllaceae), Hemi, Fendler sandwort, (N) (V)
ARTEM	Artemisia sp.
Ardr	Artemisia dracunculus L.; (Compositae), Hemi, Tarragon, (N) (V)
Arlu	Artemisia ludoviciana Nutt.; (Compositae), Hemi, Louisiana sagebrush, (N) (V)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Ascr	Asclepias cryptoceras S. Wats.; (Asclepidaceae), Hemi, milkweed, (N) (V)
ASTER	Aster sp.
Asar 6	Aster arenosus Blake; (Compositae), Hemi, aster, (N) (V)
Asca 4	Aster campestris Nutt.; (Compositae), Hemi, aster, (N) (V)
ASTRA	Astragalus sp.
Asch	Astragalus chamaeleuce A. Gray; (Leguminosae), Hemi, milk-vetch, (N) (V)
Asdi	Astragalus diversifolius A. Gray; (Leguminosae), Hemi, milk-vetch, (N) (V)
Aslu	Astragalus lutosus M.E. Jones; (Leguminosae), Hemi, milkvetch, (threatened and endangered--endemic to Green River shale deposits), (N) (V)
Aspu	Astragalus purshii Dougl. ex. Hook; (Leguminosae), Hemi, Pursh locoweed, (N) (V)
Assp 3	Astragalus spatulatus Sheld.; (Leguminosae), Hemi, tufted milkvetch, (N) (V)
Aste 3	Astragalus tenellus Pursh; (Leguminosae), Hemi, loose flower milkvetch, (N) (V)
Basa	Balsamorhiza sagittata (Pursh) Nutt.; (Compositae), Hemi, arrowleaf balsam root, (N) (V)
BORAG	Boraginaceae
CALOC	Calochortus sp.
Canu	Calochortus nuttallii Torr.; (Liliaceae), Cryp, segolily mariposa, (N) (V)
Cagu	Calochortus gunnisonii S. Wats.; (Liliaceae), Cryp, (N)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Cabu	Capsella bursa-pastoris (L.) Medic.; (Cruciferae), Ther, shepherds-purse, (I)
Cach 3	Castilleja chromosa A. Nels.; (Scrophulariaceae), Hemi, Indian paintbrush, (N) (V)
Cali	Castilleja linariaefolia Benth in D.C.; (Scrophulariaceae), Hemi, Wyoming painted cup (N) (V)
CHAEN	Chaenactis sp.
Chdo	Chaenactis douglasii (Hook) Hook & Arn.; (Compositae), Hemi, Douglas chaenactis, (N) (V)
CHENO	Chenopodium sp.
Chal	Chenopodium album L.; (Chenopodiaceae), Ther, lambsquarter goosefoot, (I) (V)
Chfr 2	Chenopodium fremontii S. Wats.; (Chenopodiaceae), Ther, Fremont goosefoot, (N) (V)
	Chenopodium gigantospermum; See Chenopodium hybridum
Chgi	Chenopodium hybridum (L.); (Chenopodiaceae), Ther, mapleleaf goosefoot, (origin uncertain), (V)
Chle	Chenopodium leptophyllum Nutt.; (Chenopodiaceae), Ther, slimleaf goosefoot, (N) (V)
Chte	Chorispora tenella D.C.; (Cruciferae), Ther, chorispora, (I) (V)
CIRSI	Cirsium sp.
Ciar 2	Cirsium arvense (L.) Scop.; (Compositae), Hemi, Canada thistle, (I) (V)
	Cirsium lanceolatum; See Cirsium vulgare

Table 3-7-3 (Continued)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Ciun	Cirsium undulatum (Nutt.) Spreng.; (Compositae), Hemi, wavyleaf thistle, (N) (V)
Civu	Cirsium vulgare (Savi) Tenore; (Compositae), Hemi, bull thistle, (I) (V)
Clco	Clematis columbiana (Nutt) T.& G.; (Ranunculaceae), Hemi, (N)
Clhi	Clematis hirsutissima Pursh; (Ranunculaceae), Hemi, Douglas clematis, (N) (V)
Clps	Clematis pseudoalpina (Kuntze) A. Nels. in Coult. & Nels; (Ranunculaceae), Hemi, (N) (V)
Copa 2	Collinsia parviflora Dougl. in Lindl.; (Scrophulariaceae), Ther, little flower collinsia, (N) (V)
Coli	Collomia linearis Nutt.; (Polemoniaceae), Ther, slenderleaf collomia, (N) (V)
Copa	Comandra umbellata ssp. pallida (A. DC.) Piehl; (Santalaceae), Hemi, bastard toadflax, (N) (V)
COMPO	Compositae
Coau	Corydalis aurea Willd.; (Fumariaceae), Ther, golden corydalis, (N) (V)
CREPI	Crepis sp.
Crac	Crepis acuminata Nutt.; (Compositae), Hemi, tapertip hawksbeard, (N) (V)
Croc	Crepis occidentalis Nutt.; (Compositae), Hemi, western hawksbeard, (N) (V)
CRUCI	Cruciferae
CRYPT	Cryptantha sp.

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Crse	Cryptantha sericea (A. Gray) Payson; (Boraginaceae), Hemi, (N) (V)
CYMOP	Cymopterus sp.
Cyac	Cymopterus acaulis (Pursh) Raf.; (Umbelliferae), Cryp, (N) (V)
Cyfe	Cymopterus fendleri A. Gray; (Umbelliferae), Cryp, Chimaya, (N) (V)
DELPH	Delphinium sp.
Dene	Delphinium nelsonii Green; (Ranunculaceae), Hemi, Menzies larkspur, (N) (V)
DESCU	Descurainia sp.
Depi	Descurainia pinnata (Walt.) Britt; (Cruciferae), Ther, pinnate tanseymustard, (N)
Deri	Descurainia richardsonii (Sweet) O.E. Schulz; (Cruciferae), Ther, Richardson tanseymustard, (N) (V)
Epad	Epilobium adenocaulon Hausskn.; (Onograceae), Hemi, sticky willowweed, (N) (V)
EQUIS	Equisetum sp.
Eqla	Equisetum laevigatum A. Br.; (Equisetaceae), Cryp, smooth horsetail, (N) (V)
ERIGE	Erigeron sp.
Erea	Erigeron eatonii A. Gray; (Compositae), Hemi, Eaton fleabane, (N) (V)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Erpu 2	Erigeron pumilus Nutt.; (Compositae), Hemi, low fleabane, (N) (V)
Ersp	Erigeron speciosus (Lindl.) DC.; (Compositae), Hemi, Oregon fleabane
ERIOG	Eriogonum sp.
Eral	Eriogonum alatum Torr.; (Polygonaceae), Hemi, wing eriogonum, (N) (V)
Ervi	Eriogonum densum Greene; (Polygonaceae), Hemi, broom eriogonum, (N) (V)
Erlo	Eriogonum lonchophyllum T. & G.; (Polygonaceae), Hemi, eriogonum, (N) (V)
Erov	Eriogonum ovalifolium Nutt.; (Polygonaceae), Hemi, cushion eriogonum, (N) (V)
Erum	Eriogonum umbellatum Nutt.; (Polygonaceae), Hemi, sulfur eriogonum, (N) (V)
Erar 6	Erysimum asperum (Nutt.) DC.; (Polygonaceae), Hemi, plains erysimum, (N) (V)
EUPHO	Euphorbia sp.
Eufe	Euphorbia fendleri T. & G.; (Euphorbiaceae), Hemi, Fendler euphorbia, (N) (V)
Euro	Euphorbia robusta (Engelm.) Small; (Euphorbiaceae), Hemi, robust euphorbia, (N) (V)
FRAGA	Fragaria sp.
Frsp	Frasera speciosa Douglas; (Gentianaceae), Hemi, showy frasera, (N) (V)
Frat	Fritillaria atropurpurea Nutt.; (Liliaceae), Cryp, purplespot fritillaria, (N) (V)

Table 3-7-3 (Continued)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Gabo	Galium boreale L.; (Rubiaceae), Hemi, northern bedstraw, (N) (V)
Geri	Geranium richardsonii Fisch. & Trautv.; (Geraniaceae), Hemi, Richardson geranium, (N) (V)
	Gilia spp ; See Ipomopsis sp..
Gymu	Gymnolomia multiflora (Nutt.)Benth & Hook.; (Compositae), Hemi, showy goldeneye, (N) (V)
Hafl	Hackelia floribunda (Lehm.) Johnston; (Boraginaceae), Hemi stickseed, (N) (V)
HAPLO	Haplopappus sp.
Haac	Haplopappus acaulis (Nutt.) A. Gray; (Compositae), Hemi, stemless goldenweed, (N) (V)
Hanu	Haplopappus nuttallii T. & G.; (Compositae), Hemi, goldenweed, (N) (V)
HEDYS	Hedysarum sp.
Hebo	Hedysarum boreale Nutt.; (Leguminosae), Hemi, northern sweetvetch, (N) (V)
Heun	Helianthella uniflora (Nutt.) T.&G.; (Compositae), Hemi, oneflower helianthella, (N) (V)
Hela	Heracleum lanatum Michx.; (Umbelliferae), Hemi, common cowparsnip, (N) (V)
Hepa	Heuchera parviflora Nutt. ex. T. & G.; (Saxifragaceae), Hemi, littleleaf alumroot, (N) (V)
Hyfi	Hymenopappus filifolius Hook.; (Compositae), Hemi, fineleaf hymenopappus, (N) (V)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
HYMEN	Hymenoxys sp.
Hyac	Hymenoxys acaulis (Pursh) Parker; (Compositae), Hemi, stemless hymenoxys, (N) (V)
Ipag	Ipomopsis aggregata (Pursh) V. Grant; (Polemoniaceae), Hemi, skyrocket gilia, (N) (V)
Ipco	Ipomopsis congesta (Hook.) V. Grant; (Polemoniaceae), Hemi, ballhead gilia, (N) (V)
KOCHI	Kochia sp.
Koir	Kochia iranica Bornm.; (Chenopodiaceae), Ther, summer cypress (I)
	Kochia scoparia; See Kochia iranica
LACTU	Lactuca sp.
Lase	Lactuca serriola L.; (Compositae), Ther, prickly lettuce, (I)
LAPPU	Lappula sp.
Lare	Lappula redowskii (Hornem.) Greene; (Boraginaceae), Ther, annual stickseed, (N) (V)
LEPID	Lepidium sp.
Lemo	Lepidium montanum Nutt.; (Cruciferae), Hemi, pepperweed, (I) (V)
Lepe	Lepidium perfoliatum L.; (Cruciferae), Ther, clasping pepperweed, (I) (V)
Lepu	Leptodactylon pungens (Torr.) Rydb.; (Polemoniaceae), Hemi, (N) (V)
Lipo	Ligusticum porteri C.& R.; (Umbelliferae), Hemi, Porter ligusticum, (N) (V)

Table 3-7-3 (Continued)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Liki	Linum kingii Wats. in King; (Linaceae), Hemi, flax, (N) (V)
Lile	Linum lewisii Pursh; (Linaceae), Hemi, Lewis flax, (N) (V)
LITHO	Lithospermum sp.
Liin	Lithospermum incisum Lehm.; (Boraginaceae), Hemi, gromwell, (N) (V)
Liru	Lithospermum ruderale Dougl. in Lehm.; (Boraginaceae), Hemi, (N) (V)
LOMAT	Lomatium sp.
Logr	Lomatium grayi C. & R.; (Umbelliferae), Cryp, desert parsley, (N) (V)
Loju	Lomatium juniperinum (M.E. Jones) C. & R.; (Umbelliferae), Cryp, desert parsley, (N) (V)
Loor	Lomatium orientale C.& R.; (Umbelliferae), Cryp, desert parsley, (N) (V)
LUPIN	Lupinus sp.
Luar	Lupinus argenteus Pursh; (Leguminosae), Hemi, silvery lupine, (N) (V)
Luca	Lupinus caudatus Kellogg; (leguminosae), Hemi, tailcup lupine, (N) (V)
Lyju	Lygodesmia juncea (Pursh) D. Don.; (Compositae), Hemi, rush skeletonplant, (N) (V)
MALVA	Malva sp.; (Malvaceae), Hemi, mallow (N)
Mear	Mentha arvense L.; (Labiateae), Hemi, field mint, (N) (V)
MENTZ	Mentzelia sp.
Meal 2	Mentzelia albicaulis Dougl. ex Hook.; (Loasaceae), Ther, whitestem mentzelia, (N) (V)

Table 3-7-3 (Continued)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Memu 2	Mentzelia multicaulis (Osterhout) Goodman; (Loasaceae), Hemi, mentzelia, (N) (V)
Memu	Mentzelia multiflora (Nutt.) Gray; (Loasaceae), Hemi, desert mentzelia, (N) (V)
MERTE	Mertensia sp.
Meci	Mertensia ciliata (James) G. Don; (Broaginaceae), Hemi, mountain bluebells, (N) (V)
Mopa	Moldavica parviflora (Nutt.) Britton; (Labiateae), Ther, American dragonhead, (N) (V)
MOSS	Moss
Niat	Nicotiana attenuata Torr. ex. S. Wats.; (Solanaceae), Ther, Coyote tobacco, (N) (V)
Oeca	Oenothera caespitosa Nutt.; (Onogríaceae), Hemi, tufted evening-primrose
Oeco	Oenothera coronopifolia T. & G.; (Onograceae), Hemi, evening-primrose, (N) (V)
Oela	Oenothera lavandulaefolia T. & G.; (Onograceae), Hemi, lavenderleaf evening-primrose, (N) (V)
OSMOR	Osmorhiza sp.
Osde	Osmorhiza depauperata Phil.; (Umbelliferae), Hemi, sweetroot, (N) (V)
Oxla	Oxytropis lambertii var. bigelovii A. Gray; (Leguminosae), Hemi, Lambert crazyweed, (N) (V)
PENST	Penstemon sp.
Peca	Penstemon caespitosus Nutt. ex. A. Gray; (Scrophulariaceae), Hemi, mat penstemon, (N) (V)
Pefr	Penstemon fremontii T. & G.; (Scrophulariaceae), Hemi, beardtongue, (N) (V)
Peos	Penstemon osterhoutii Pennell; (Scrophulariaceae), Hemi, beardtongue, (N) (V)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Pest	Penstemon strictus Benth. in D.C.; (Scrophulariaceae), Hemi, Rocky Mountain penstemon, (N) (V)
Phse	Phacelia sericea (Graham) A. Gray; (Hydrophyllaceae), Hemi, silky phacelia, (N) (V)
PHLOX	Phlox sp.
Phho	Phlox hoodii Rich.; (Polemoniaceae), Hemi, Hoods phlox, (N) (V)
Phlo	Phlox longifolia Nutt.; (Polemoniaceae), Hemi, longleaf phlox, (N) (V)
Phmu	Phlox multiflora A. Nels.; (Polemoniaceae), Hemi, flowery phlox, (N) (V)
Phfl	Physaria floribunda Rydb.; (Cruciferae), Hemi, twinpod, (N) (V)
PLANT	Plantago sp.; (Plantaginaceae), Ther, plantain, (N)
Plpa	Plantago patagonica Jacq.; (Plantaginaceae), Ther, Patagonia Indianwheat, (N)
	Plantago purshii See Plantago patagonica
Posa 3	Polygonum sawatchense Small; (Polygonaceae), Ther, knotweed, (N) (V)
POTEN	Potentilla sp.
Pomo	Potentilla monspeliensis L.; (Rosaceae), Ther, cinquefoil, (origin uncertain) (V)
Popu	Potentilla pulcherrima Lehm.; (Rosaceae), Hemi, cinquefoil (N) (V)
Poqu	Potentilla quinquefolia Rydb.; (Rosaceae), Hemi, cinquefoil, (N) (V)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
Pyas	Pyrola asarifolia Michx.; (Ericaceae), Hemi, alpine pyrola, (N) (V)
RANUN	Ranunculus sp.
Racy	Ranunculus cymbalaria var. saximontanus Fernald; (Ranunculaceae), Hemi, Rocky Mountain buttercup, (N) (V)
Rasc 2	Ranunculus sceleratus L.; (Ranunculaceae), Hemi, blister buttercup, (N) (V)
RORIP	Rorippa sp.
Rona	Rorippa nasturtium-aquaticum (L.) Schniz & Thell.; (Cruciferae), Hemi, watercress, (I) (V)
Rucr	Rumex crispus L.; (Polygonaceae), Hemi, curlydock, (N) (V)
Ruut	Rumex utahensis Rech, f.; (Polygonaceae) Hemi, dock, (N) (V)
Saka	Salsola kali L.; (Chenopodiaceae), Ther, Russianthistle, (I) (V)
Scla	Scrophularia lanceolata Pursh,(Scrophulariaceae), Hemi lanceleaf figwort, (N) (V)
SENEC	Senecio sp.
Sein	Senecio integerrimus Nutt.; (Compositae), Hemi, lambstongue groundsel, (N) (V)
Semu 2	Senecio multilobatus T.& G. ex A. Gray; (Compositae), Hemi, lobeleaf groundsel, (N) (V)
Sesp	Senecio spartioides T&G(Compositae), Hemi, broom groundsel, (N) (V)
SISYM	Sisymbrium sp.
Sial	Sisymbrium altissimum L.; (Cruciferae), Ther, tumblemustard, (N) (V)
Sili	Sisymbrium linifolium Nutt. in T.& G.; (Cruciferae), Hemi, tumblemustard, (N) (V)

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
SMILA	Smilacina sp.
Smra	Smilacina racemosa var. amplexicaulis (Nutt.) S. Wats.; (Liliaceae), Cryp, Solomon-plume, (N) (V)
Smst	Smilacina stellata (L.) Desf.; (Liliaceae), Cryp, Solomon-plume, (N) (V)
SOLID	Solidago sp; (Compositae), Hemi, goldenrod, (N) (V)
	Solidago ciliosa See: Solidago multiradiata var. scopulorum
Somu	Solidago multiradiata Ait. var. scopulorum A. Gray; (Compositae) Hemi, low goldenrod, (N) (V)
SPHAE	Spaheralcea sp.
Spco	Sphaeralcea coccinea (Pursh) Rydb.; (Malvaceae), Hemi, scarlet globemallow, (N) (V)
Stpi 2	Stanleya pinnata (Pursh) Britton; (Cruciferae), Hemi, desert princesplume, (N) (V)
Stwr	Stanleyella wrightii See: Thelypodium wrightii
Stco	Streptanthus cordatus Nutt. ex T.& G.; (Cruciferae), Hemi, heartleaf twistflower, (N) (V)
TARAX	Taraxacum sp.
Taof	Taraxacum officinale Web. in Wiggers; (Compositae), Hemi, common dandelion, (Distribution worldwide) (V)
Thfe	Thalictrum fendleri Engelm. ex A. Gray; (Ranunculaceae), Hemi, Fendler meadowrue, (N) (V)
Thwr	Thelypodium wrightii A. Gray; (Curciferae), Hemi or Ther, (N) (V)

Abbrev.	Species
	HERBACEOUS (NON GRASSLIKE) (Cont.)
Thmo	Thermopsis montana Nutt. ex T.& G.; (Leguminoseae), Hemi, mountain thermopsis, (N) (V)
Toin	Townsendia incana Nutt.; (Compositae), Hemi, hoary townsendia, (N) (V)
TRIFO	Trifolium sp.
Trgy	Trifolium gymnocarpon Nutt.; (Leguminoseae), Hemi, hollyleaf clover, (N) (V)
UMBEL	Umbelliferae
Urdig	Urtica dioica ssp. gracilis (A.T.) Selander; (Labiatae), Hemi or Ther, big stinging nettle, (N)
Vaoc	Valeriana occidentalis Heller; (Valerianaceae), Hemi, western valerian, (N) (V)
Viam	Vicia americana Muehl. ex. Willd.; (Leguminoseae), Hemi American vetch, (N) (V)
	Viguiera multiflora See: Gymnolomia multiflora
Viad	Viola adunca Smith; (Violaceae), Hemi, Hook violet, (N) (V)
Vicar	Viola canadensis L. var. rugulosa (Greene) C.L. Hitchcock; (Violaceae), Hemi, Canada violet (N) (V)
Vinu	Viola nuttallii Pursh; (Violaceae), Hemi, Nuttall violet, (N) (V)
Vipa 2	Viola pallens (Banks) Brainerd; (Violaceae), Hemi, marsh violet, (N) (V)
	Viola palustris ssp. brevipes; See Viola pallens
	Viola rugulosa; See Viola canadensis var. rugulosa

Abbrev.	Species
	HERBACEOUS (NON-GRASSLIKE) (Cont.)
WYETH	Wyethia sp. Nutt.; (Compositae), mule-ears
Zyveg	Zygadenus venenosus var. gramineus (Rydb.) Walsh ex M.E. Peck; (Liliaceae), Cryp, grassy deathcamas, (N) (V)
	GRASSES AND GRASS-LIKES
AGROP	Agropyron sp.
	Agropyron cristatum; See Agropyron desertorum
Agde 2	Agropyron desertorum (Risch.) Schult.; (Gramineae), Hemi, crested wheatgrass, (I) (N)
	Agropyron inerme; See Agropyron spicatum var. inerme
Agre 2	Agropyron repens (L.) Beauv.; (Gramineae), Hemi, quackgrass, (I) (V)
Agsm	Agropyron smithii Rydb.; (Gramineae), Bluestem wheatgrass, (N) (V)
Agspi	Agropyron spicatum (Pursh) Scribn. & Smith var. inerme Heller; (Gramineae), Hemi, beardless bluebunch wheatgrass, (N) (V)
Agsp	Agropyron spicatum (Pursh) Scribn. & Smith var. spicatum; (Gramineae), Hemi, bearded bluebunch wheatgrass, (N) (V)
Agsu	Agropyron subsecundum (Link) Hitchc.; (Gramineae), bearded wheatgrass, (N) (V)
Agtr	Agropyron trachycaulum (Link) Richt; (Gramineae), Hemi, slender wheatgrass, (N) (V)
ARIST	Aristida sp. L. Three awn, (N)
Bogr	Bouteloua gracilis (H.B.K.) Lag.; (Gramineae), Hemi, blue grama, (N) (V)

Table 3-7-3 (Continued)

Abbrev.	Species
	GRASSES AND GRASS-LIKES (Cont.)
BROMU	Bromus sp.
	Bromus anomalus; See Bromus porteri
Brin	Bromus inermis Leyss; (Gramineae), Hemi, smooth brome, (I) (V)
Brma	Bromus marginatus Nees; (Gramineae), Hemi, big mountain brome, (N) (V)
Brpo	Bromus porteri, (Coult.) Nash; (Gramineae), Hemi, nodding brome, (N)
Brte	Bromus tectorum L.; (Gramineae), Ther, cheatgrass brome, (I) (V)
CAREX	Carex sp.
Cado	Carex douglasii Boot in Hook.; (Cyperaceae), Cryp, Douglas sedge, (N) (V)
Cage	Carex geyeri Boott; (Cyperaceae), Cryp, elk sedge, (N) (V)
Cala 2	Carex lanuginosa Michx.; (Cyperaceae), Cryp, wooly sedge, (N) (V)
Cane 2	Carex nebraskensis Dewey; (Cyperaceae), Cryp, Nebraska sedge, (N) (V)
Cave 2	Carex vernacula L.H. Bailey; (Cyperaceae), Cryp, sedge, (N) (V)
Dist	Distichlis stricta (Torr.) Rydb.; (Gramineae) Hemi, inland saltgrass, (N) (V)
Elma	Eleocharis macrostachya Britt.; (Cyperaceae), Cryp, common spikerush, (N) (V)
ELYMU	Elmus sp.
Elci	Elymus cinereus Scribn. & Merr.; (Gramineae), Hemi, great basin wildrye, (N) (V)
FESTU	Festuca sp.; (Gramineae), Hemi, fescue, (N)

Abbrev.	Species
	GRASSES AND GRASS-LIKES (Cont.)
Glst	Glyceria striata (Lam.) Hitchcock; (Gramineae), Hemi, fowl mannagrass, (N) (V)
HORDE	Hordeum sp.
Hobr	Hordeum brachyantherum Nevski; (Gramineae), Hemi, meadow barley, (N) (V)
Hoju	Hordeum jubatum L.; (Gramineae), Hemi, foxtail barley, (N) (V)
JUNCU	Juncus sp.
Juara	Juncus articus spp. ater (Rydb.) Hulten; (Juncaceae), Cryp, wiregrass, (N) (V)
	Juncus balticus; See Juncus arcticus spp. ater
Jusa	Juncus saximontanus A. Nels.; (Juncaceae) Cryp, Rocky Mountain rush, (N) (V)
	Koeleria cristata; See Koeleria gracilis
Kogr	Koeleria gracilis Pers.; (Gramineae), Hemi, prairie junegrass
Mebu	Melica bulbosa Geyer; (Gramineae), Cryp, onion grass, (N)
Orhy	Oryzopsis hymenoides (R.& S.) Ricker; (Gramineae), Hemi, Indian ricegrass, (N) (V)
POA	Poa sp.
Poag	Poa agassizensis Boivin & D. Loeve; (Gramineae), Hemi, blue grass, (N) (V)
Poam	Poa ampla Merr.; (Gramineae), Hemi, big bluegrass, (N) (V)
Poca	Poa canbyi (Scribn.) Piper; (Gramineae), Hemi, Canby bluegrass, (N) (V)
Poco	Poa compressa L.; (Gramineae), Hemi, Canada bluegrass, (N) (N)
Pofe	Poa fendleriana (Steud.) Vasey; (Gramineae), Hemi, mutton bluegrass, (N) (V)

Abbrev.	Species
	GRASSES AND GRASS-LIKES (Cont.)
	Poa interior; See *Poa nemoralis* var. *interior*
Ponei	*Poa nemoralis* L. var. *interior* (Rydb.) Butters & Abbe; (Gramineae), Hemi, interior bluegrass, (N) (V)
Popr	*Poa pratensis* L.; (Gramineae), Hemi, Kentucky bluegrass, (I) (V)
Posa	*Poa sandbergii* Vasey; (Gramineae), Hemi, Sandberg bluegrass, (N) (V)
	Poa secunda; See *Poa sandbergii*
Scac	*Scirpus acutus* Muehl. ex. Bigelow; (Cyperaceae), Cryp, tule bulrush, (N) (V)
	Sitanion hystrix; See *Sitanion longifolium*
Silo	*Sitanion longifolium* J.G. Smith; (Gramineae), Hemi, squirreltail, (N) (V)
Spai	*Sporobolus airoides* (Torr.) Torr.; (Gramineae), Hemi, alkali sacaton, (N) (V)
STIPA	*Stipa* sp.
Stco 2	*Stipa columbiana* Mocoun; (Gramineae), Hemi, subalpine needlegrass. (N) (V)
Stco	*Stipa comata* Trin. & Rupr.; (Gramineae), Hemi, needle-and-thread, (N) (V)
Stvi	*Stipa viridula*, Trin.; (Gramineae), Hemi, green needlegrass, (N)
Trma 3	*Triglochin maritima* L.; (Juncaginaceae), Cryp, shore podgrass, (N)
Tyla	*Typha latifolia* L.; (Typhaceae), Cryp, common cattail, (N)

Table 3-7-3 (Continued)

Abbrev.	Species

FOOTNOTES

1/ Abbreviation of genus and species in a four letter code (Plummer et al., 1966).

2/ Author citation, nomenclatural authority cited after each species name and delineated by a semicolon.

3/ The family of plants to which a species belongs in parenthesis.

4/ Lifeforms of Plants (Raunkiaer, 1934).

Phan (Phanerophyte) - Perennating bud at least 0.25 m above soil surface.

Cham (Chamaephyte) - Perennating bud between 0 and 0.25 m above soil surface.

Hemi (Hemicryptophyte) - Perennating bud in soil surface.

Cryp (Cryptophyte) - Perennating buds covered by soil or water.

Ther (Therophyte) - Annual plants, perennating buds contained in seed.

Succ (Succulent) - Stems enlarged; serve as water storage organ.

5/ (V) Voucher speciment collected.

6/ Origin of herbaceous species:

(N) - Native to the North American Continent.

(I) - Introduced from outside the North American Continent.

Table 3.7-4

THE RELATIVE ECOLOGICAL AMPLITUDE OF PLANT SPECIES SAMPLED IN THE TRACT C-a STUDY AREA FOR RBOSP

Species	Douglas Fir	Aspen	Upland Meadow	Mixed Brush Quga/Amut	Mixed Brush Amut/Syor	Pinyon-Juniper P-J/Amut	Pinyon-Juniper P-J	Pinyon-Juniper P-J/Artr	Sagebrush Artr/Amut/Syor	Sagebrush Artr	Shadscale	Rabbitbrush	Greasewood	Riparian
TREE STRATUM														
Juos	-	-	+	-	+	13	13	11	+	-	-	-	-	-
Pied	-	-	+	-	+	4	15	9	+	-	+	-	-	-
Potr	1	51	-	+	-	-	-	-	-	-	-	-	-	6
Psme	60	1	-	-	+	-	-	-	-	-	-	-	-	+
SHRUBS														
Acgl	2	4	-	-	-	-	-	-	-	-	-	-	-	-
Amal	7	19	-	+	-	-	-	-	-	-	-	-	-	-
Amut	12	14	3	39	26	8	+	+	4	+	-	-	-	1
Arfr	-	-	1	-	-	-	+	-	-	-	+	-	-	-
Artr	+	+	+	8	8	7	+	7	21	31	7	-	10	5
Atca	-	-	-	-	-	-	-	-	-	+	+	2	-	+
Atco	-	-	-	-	-	+	+	-	-	+	4	-	+	+
Befo	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Cema	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Cemo	+	-	+	+	2	1	1	+	+	-	-	-	-	-
Chde	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Chna	+	-	-	-	+	+	+	-	+	3	+	14	4	2
Chvi	+	-	+	+	1	+	+	1	1	3	+	21	+	+
Epvi	-	-	-	-	-	-	+	-	-	-	+	-	-	-
Eula	-	-	+	-	-	-	-	+	+	+	+	-	-	-
Gusa	-	-	1	-	+	+	+	+	+	-	-	-	-	+
Hodu	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Mare	+	-	+	+	-	-	-	-	-	-	-	-	-	-
Opfr	-	-	-	-	-	+	-	+	-	-	-	-	-	-
Oppo	-	-	-	-	+	+	+	+	+	+	-	-	-	-
Pamy	+	+	-	-	-	-	-	-	-	-	-	-	-	+
Pvim	10	12	-	3	-	-	-	-	-	-	-	-	-	1
Putr	+	-	+	4	+	1	1	1	+	-	-	-	-	-
Quga	2	+	-	12	-	-	-	-	-	-	-	-	-	-
Riau	-	-	-	-	-	-	-	-	-	-	-	+	-	2
Rice	+	-	-	-	-	-	-	-	-	+	-	-	-	+
Riin	2	1	-	+	+	-	-	-	-	-	-	-	-	1
Rowo	1	4	-	+	-	-	-	-	+	-	-	-	-	3
Saex	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Sain	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Saco	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Save	-	-	-	-	-	-	-	-	-	1	+	2	29	+
Sosc	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Swse	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Syor	11	3	+	13	12	1	+	+	2	-	+	+	-	3
Teca	-	-	+	+	+	+	+	+	+	5	+	-	-	-
FORBS														
Acla	1	+	+	+	-	-	-	-	+	-	-	-	-	+
Aggl	-	-	-	+	-	-	-	+	+	-	-	-	-	-
Anse	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Anam	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Anmi	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Anpu	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Aqca	+	1	-	-	-	-	-	-	-	-	-	-	-	-
Ardr	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Area	-	-	+	-	-	-	-	+	-	-	+	-	-	-
Arlu	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Asca	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Asch	-	-	+	+	-	-	-	-	+	-	-	-	-	-
Asdi	-	-	-	-	+	+	-	+	-	+	-	-	-	-
Aspu	-	-	+	-	-	-	+	-	+	-	-	-	-	-
Assp 3	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Aste 3	2	-	-	-	-	-	-	-	+	-	-	-	-	-
Basa	-	-	-	-	+	-	+	-	-	-	-	-	-	-
Canu	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Cach 3	-	-	+	-	-	-	-	-	+	-	-	-	-	-
Cali	-	-	+	-	-	+	-	-	+	-	-	-	-	-
Chdo	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Chal	-	-	-	-	-	-	-	-	-	-	-	-	6	+
Chfr 2	+	-	-	-	+	+	+	-	-	+	+	+	3	+
Chle	+	-	-	-	-	-	-	-	-	+	-	-	-	+
Ciar 2	+	-	-	-	-	-	-	-	-	-	-	-	-	+

Table 3.7- 4

(CONTINUED)

Species	Douglas Fir	Aspen	Upland Meadow	Mixed Brush		Pinyon-Juniper			Sagebrush		Shadscale	Rabbitbrush	Greasewood	Riparian
				Quga/Amut	Amut/Syor	P-J/Amut	P-J	P-J/Artr	Artr/Amut/Syor	Artr				
FORBS (CONTINUED)														
Clco	+	-	-	-	-	-	-	-	-	-	-	-	-	+
Clhi	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Coli	+	-	-	-	-	-	-	-	+	-	-	-	-	-
Copa	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Coum	-	-	+	+	-	-	-	-	+	-	-	-	-	-
Crac	-	-	-	+	+	-	+	-	+	-	-	-	-	-
Crse	-	-	+	+	+	+	+	+	+	+	+	-	-	-
Depi	-	-	-	-	-	-	-	-	-	-	+	+	+	+
Eras	-	-	-	-	+	-	-	-	+	-	-	-	-	-
Erea	-	-	+	-	+	-	+	-	+	-	-	-	-	-
Erpu 2	-	-	-	-	+	-	-	+	+	-	-	-	-	-
Ersp	+	-	-	-	-	-	-	-	+	-	-	-	-	-
Eral	-	-	+	-	-	-	-	-	-	+	-	-	-	-
Erlo	-	-	1	-	-	1	-	+	-	-	1	-	-	-
Erov	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Erum	-	-	-	+	2	-	+	-	1	-	-	-	-	-
Eufe	-	-	-	-	-	+	+	+	-	+	-	-	-	-
Euro	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Gefr	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Gabo	1	3	-	+	-	-	-	-	1	-	-	-	-	+
Geri	-	1	-	-	-	-	-	-	-	-	-	-	-	+
Hafl	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Haac	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Hanu	-	-	1	-	+	1	+	+	+	-	1	-	-	-
Hebo	-	-	1	-	+	-	-	-	1	-	-	-	-	-
Heun	+	+	-	-	-	-	-	-	+	-	-	-	-	-
Hepa	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Hyfi	-	-	1	-	-	-	-	+	-	-	-	-	-	-
Hyac	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Ipag	-	-	+	+	-	-	-	-	+	+	-	-	-	-
Ipco	-	-	-	-	-	-	-	+	+	-	-	-	-	-
Koir	-	-	-	-	-	-	-	-	-	+	-	-	9	+
Lase	-	-	-	-	-	-	-	-	-	-	-	-	+	-
re	-	-	-	-	-	-	-	-	-	+	-	-	+	-
pe	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Lepu	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Lile	-	-	+	-	+	-	-	-	-	-	-	-	-	-
Liru	+	-	-	-	+	-	-	-	-	-	-	-	-	-
Luca	-	-	+	-	+	-	-	-	4	-	-	-	-	-
Lyju	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Oeca	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Oela	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Osde	1	5	-	-	-	-	-	-	+	-	-	-	-	-
Oxla	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Peca	-	-	2	+	+	+	+	-	1	-	-	-	-	-
Pefr	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Phho	-	-	+	-	-	+	+	+	+	-	-	-	-	-
Phlo	-	-	+	+	+	-	-	+	+	-	-	-	+	-
Phmu	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Phfl	-	-	+	+	+	+	-	+	+	+	-	-	-	-
Posa	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Popu	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Racy	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Ruut	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Semu	-	-	-	-	-	-	+	-	-	+	-	-	-	-
Smst	+	1	-	-	-	-	-	-	-	-	-	-	-	+
Somus	1	2	-	-	-	-	-	-	-	-	-	-	-	+
Spco	-	-	+	-	+	+	+	1	1	-	+	-	-	-
Stco	-	-	+	-	-	-	-	-	-	-	-	-	-	-
Taof	+	+	-	-	-	-	-	-	+	+	-	-	+	1
Thfe	3	1	-	-	-	-	-	-	-	-	-	-	-	-
Thmo	+	5	-	-	-	-	-	-	-	-	-	-	-	-
Trgy	-	-	+	-	-	+	-	+	1	-	-	-	-	-
Vaoc	-	2	-	-	-	-	-	-	-	-	-	-	-	-
Viam	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Viad	1	-	-	-	-	-	-	-	-	-	-	-	-	-
iru	-	6	-	-	-	-	-	-	-	-	-	-	-	-
veg	-	-	+	-	-	-	-	-	+	-	-	-	-	-

Table 3.7- 4

(CONTINUED)

Species	Douglas Fir	Aspen	Upland Meadow	Mixed Brush Quga/Amut	Mixed Brush Amut/Syor	Pinyon-Juniper P-J/Amut	Pinyon-Juniper P-J	Pinyon-Juniper P-J/Artr	Sagebrush Artr/Amut/Syor	Sagebrush Artr	Shadscale	Rabbitbrush	Greasewood	Riparian
GRASSES AND GRASS-LIKES														
Agde 2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
Agre2	-	-	-	-	-	-	-	-	-	-	-	-	-	14
Agsm	-	-	+	+	-	+	+	+	1	2	-	1	5	-
Agspi	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Agin	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Agtr	+	-	2	+	1	1	+	1	-	+	-	-	+	-
Bogr	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Brin	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Brma	+	2	-	-	-	-	-	-	-	-	-	-	-	-
Brte	-	-	-	+	-	-	-	-	+	+	-	-	+	-
Cage	10	3	-	6	+	-	+	+	3	-	-	-	-	-
Cane	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Cave	-	2	-	-	-	-	-	-	-	-	-	-	-	1
Elci	-	-	-	-	+	-	-	-	-	2	-	37	+	7
Glst	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Hobr	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Hoju	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Juara	-	-	-	-	-	-	-	-	-	-	-	1	-	+
Jusa	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Kogr	+	1	2	-	+	-	+	1	+	+	-	-	-	-
Orhy	-	-	-	1	1	+	1	1	1	+	+	-	-	-
Poam	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Pofe	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Popr	-	-	-	-	-	-	-	-	+	-	-	4	-	7
Posa	-	-	1	-	2	+	1	1	3	-	-	-	+	-
Scac	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Silo	-	-	-	-	-	+	-	+	-	1	+	-	-	-
Spai	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Stco 2	-	1	-	-	-	-	+	-	1	-	-	-	-	-
Stco	-	-	1	-	2	+	-	1	1	-	-	-	-	-

Table 3-7-5 Species encountered in the mature tree stratum in the aspen type for RBOSP

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)						
1. *Populus tremuloides*	33.04	93.75	100	3304	479	13.00
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS)						
1. *Populus tremuloides*	41.33	100.00	100	4133	623	21.08
2. *Pseudotsuga menziesii*	1.10	8.00	20	110	14	0.78
All Species	42.43			4243	637	21.86

Table 3-7-6 Percentage of individuals/ha by diameter class (cm) of tree species recorded on vegetation transects for RBOSP

Vegetation Type Species	Diameter Class (cm)*											
	0-7.6	7.6-16	16-24	24-32	32-40	40-48	48-56	56-64	64-72	72-80	80-88	>88
Douglas fir												
Pseudotsuga menziesii	67	12	11	6	3	1	<1	0	<1	0	0	0
Aspen												
Populus tremuloides	75	11	11	2	<1	<1	0	0	0	0	0	0
Pinyon-Juniper												
Juniperus osteosperma	29	11	13	10	10	11	5	4	3	<1	2	2
Pinyon-Juniper												
Pinus edulis	75	8	7	4	2	1	1	<1	1	<1	0	0

*Measured dhb (diameter breast height,=1.4m) for Pseudotsuga menziesii and Populus tremuloides and below branching (=.4 m) for Juniperus osteosperma and Pinus edulis.

Table 3-7-7 Species encountered in the shrub-tree seedling stratum in the aspen vegetation type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)										
1. *Symphoricarpos oreophilus*	*	*	*	25.79	100.00	100	2579	5188	*	**
2. *Populus tremuloides*	*	*	*	14.62	93.75	100	1462	2063	*	**
3. *Amelanchier* sp.	*	*	*	13.56	87.50	100	1356	3243	*	**
4. *Rosa woodsii*	*	*	*	4.52	62.50	75	452	1764	*	**
5. *Prunus virginiana*	*	*	*	2.08	62.50	100	208	861	*	**
6. *Quercus gambelii*	*	*	*	0.63	18.75	25	63	83	*	**
7. *Ribes* sp.	*	*	*	0.40	25.00	50	40	500	*	**
8. *Acer glabrum*	*	*	*	0.21	6.25	25	21	28	*	**
9. *Artemisia tridentata*	*	*	*	0.17	12.50	25	17	49	*	**
All Species				61.98			6198	13779		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS)										
1. *Amelanchier alnifolia*	1,2	5	2	18.81	40.00	100	1881	1367	22.08	7176
2. *Amelanchier utahensis*	1,2	5	2	13.87	52.00	100	1387	150	*	**
3. *Prunus virginiana*	1,2	5	2	12.34	88.00	100	1234	2140	3.39	1159
4. *Populus tremuloides*	1,2	2	2	9.29	96.00	100	929	923	6.41	854
5. *Acer glabrum*	1,2	5	*	4.39	44.00	60	439	103	28.25	706
6. *Rosa woodsii*	1,2	4	2,6	3.79	96.00	100	379	4483	0.05	7
7. *Symphoricarpos oreophilus*	1,2	4	2,6	3.28	100.00	100	328	3853	0.92	461
8. *Ribes* sp.	1	*	*	1.37	36.00	40	137	197	.02	1
9. *Ribes inerme*	*	5	2	1.34	24.00	40	134	1773	*	**
10. *Sorbus scopulina*	*	4	*	1.11	12.00	20	111	23	*	**
11. *Quercus gambelii*	1	*	2	0.31	8.00	40	31	7	41.63	347
12. *Pachystima myrsinites*	*	*	2	0.21	20.00	20	21	623	*	**
13. *Pseudotsuga menziesii*	2	*	*	0.00	8.00	20	0	17	*	**
14. *Artemisia tridentata*	2	*	*	0.00	8.00	40	0	13	*	**
All Species				70.11			7011	15672		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-8 Species encountered in the herbaceous stratum in the aspen type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad	Sociability
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)							
1. Carex geyeri	*	22.81	85.00	100	2281	*	**
2. Bromus marginatus	*	1.68	32.50	50	168	*	**
3. Fragaria sp.	*	0.59	20.00	75	59	*	**
4. Aster sp.	*	0.59	12.50	25	59	*	**
5. Angelica sp.	*	0.47	15.00	50	47	*	**
6. Agropyron trachycaulum	*	0.44	5.00	25	44	*	**
7. Galium boreale	*	0.39	20.00	100	39	*	**
8. Stipa sp.	*	0.35	7.50	75	35	*	**
9. Thalictrum sp.	*	0.33	20.00	75	33	*	**
10. Agropyron spicatum	*	0.21	2.50	25	21	*	**
11. Pachystima myrsinites	*	0.18	5.00	25	18	*	**
12. Lappula sp.	*	0.12	5.00	25	12	*	**
13. Smilacina sp.	*	0.12	5.00	50	12	*	**
14. Erigeron sp.	*	0.10	2.50	25	10	*	**
15. Thermopsis montana	*	0.09	7.50	50	9	*	**
16. Aquilegia caerulea	*	0.08	5.00	25	8	*	**
17. Achillea lanulosa	*	0.07	10.00	75	7	*	**
18. Geranium richardsonii	*	0.06	7.50	25	6	*	**
19. Mertensia sp.	*	0.03	2.50	25	3	*	**
20. Sisymbrium altissimum	*	0.02	2.50	25	2	*	**
21. Viola sp.	*	0.01	2.50	25	1	*	**
22. Unknown Compositae	*	0.18	5.00	50	18	*	**
23. Unknown Umbelliferae	*	0.16	7.50	25	16	*	**
All Species		29.03			2903		
MAY-JUNE 1975 (SUMMARY OF 2 TRANSECTS)							
1. Carex geyeri	2	2.60	80.00	100	260	*	**
2. Eriogonum sp.	2	0.40	10.00	50	40	*	**
3. Agropyron trachycaulum	2	0.23	40.00	50	23	*	**

Table 3-7-8 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
MAY-JUNE 1975 (SUMMARY OF 2 TRANSECTS) CONTINUED							
4. *Bromus marginatus*	2	0.20	35.00	50	20	*	**
5. *Senecio* sp.	2	0.10	10.00	50	10	*	**
6. *Smilacina* sp.	2	0.00	30.00	50	0	*	**
7. *Valeriana occidentalis*	2	0.00	15.00	50	0	*	**
8. *Mertensia brevistyla*	2	0.00	10.00	50	0	*	**
9. *Viola palustris*	3	0.00	10.00	50	0	*	**
10. *Achillea lanulosa*	2	0.00	10.00	50	0	*	**
11. *Cirsium* sp.	2	0.00	5.00	50	0	*	**
12. *Cryptantha sericea*	2	0.00	5.00	50	0	*	**
13. *Potentilla pulcherrima*	2	0.00	5.00	50	0	*	**
14. *Thalictrum fendleri*	2	0.00	5.00	50	0	*	**
15. Unknown	2	0.05	20.00	50	5	*	**
All Species		3.58			358		
JULY 1975 (SUMMARY OF 2 TRANSECTS)							
1. *Viola rugulosa*	2	6.40	30.00	50	640	4.7	15.5
2. *Thermopsis montana*	2,3,5	5.45	55.00	100	545	4.4	7.9
3. *Osmorhiza depauperata*	4,5	5.40	60.00	50	540	5.4	11.9
4. *Carex geyeri*	2	3.35	50.00	100	335	*	**
5. *Galium boreale*	2,3	3.10	90.00	100	310	6.0	6.6
6. *Solidago* sp.	2	2.30	45.00	100	230	1.3	2.9
7. *Valeriana occidentalis*	2,3,4	2.25	35.00	100	225	1.9	5.4
8. *Bromus marginatus*	2,4	2.05	50.00	100	205	*	**
9. *Carex vernacula*	2,5	1.80	40.00	50	180	*	**
10. *Aquilegia caerulea*	4	1.50	10.00	100	150	0.8	7.5
11. *Thalictrum fendleri*	2,5	1.45	50.00	100	1.45	1.4	2.7
12. *Smilacina stellata*	2	1.25	30.00	100	125	0.7	2.2
13. *Geranium richardsonii*	4	1.20	25.00	100	120	0.7	2.6
14. *Pachystima myrsinites*	2	1.00	5.00	50	100	0.8	15.0
15. *Potentilla pulcherrima*	3	0.75	5.00	50	75	0.4	7.0

Table 3-7-8 (Continued)

	Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
	JULY 1975 (SUMMARY OF 2 TRANSECTS) CONTINUED							
16.	Stipa columbiana	2	0.55	25.00	50	55	*	**
17.	Koeleria gracilis	2	0.55	15.00	50	55	*	**
18.	Hackelia floribunda	2	0.50	10.00	50	50	2.1	20.5
19.	Cirsium arvense	3	0.40	10.00	50	40	0.3	3.0
20.	Achillea lanulosa	2	0.20	10.00	100	20	0.3	3.0
21.	Taraxacum officinale	2	0.15	5.00	50	15	0.1	2.0
22.	Chenopodium leptophyllum	2	0.10	5.00	50	10	0.7	14.0
23.	Clematis columbiana	2	0.10	5.00	50	10	0.1	1.0
24.	Collomia linearis	2	0.05	5.00	50	5	0.2	3.0
25.	Helianthella uniflora	2	0.05	5.00	50	5	0.1	1.0
	All Species		41.90			4190		
	SEPTEMBER 1975 (SUMMARY OF 2 TRANSECTS)							
1.	Carex geyeri	2	6.30	90.00	100	630	*	**
2.	Thermopsis montana	2,6	3.90	55.00	100	390	3.5	6.4
3.	Viola pallens	2	2.70	15.00	50	270	3.5	23.3
4.	Bromus marginatus	6	2.20	45.00	100	220	*	**
5.	Valeriana occidentalis	2	1.60	40.00	100	160	1.8	4.5
6.	Galium boreale	2	1.55	80.00	100	155	5.1	6.3
7.	Osmorhiza depauperata	2	1.45	80.00	100	145	4.9	6.1
8.	Clematis columbiana	2	0.75	15.00	50	75	0.1	0.7
9.	Solidago multiradiata	6	0.65	10.00	50	65	0.4	3.5
10.	Thalictrum fendleri	2,6	0.60	35.00	100	60	0.9	2.6
11.	Helianthella uniflora	2,1	0.60	10.00	100	60	1.5	14.5
12.	Geranium richardsonii	2	0.55	30.00	100	55	0.3	1.0
13.	Smilacina stellata	2	0.55	20.00	100	55	0.5	2.3
14.	Stipa columbiana	6	0.55	15.00	50	55	*	**
15.	Potentilla pulcherrima	2	0.45	10.00	50	45	0.3	2.5
16.	Viola nuttallii	2	0.40	15.00	50	40	1.2	8.0
17.	Cirsium arvense	1	0.25	15.00	50	25	0.4	2.3

Table 3-7-8 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
SEPTEMBER 1975 (SUMMARY OF 2 TRANSECTS)							
18. Aquilegia caerulea	2	0.20	5.00	50	20	0.1	1.0
19. Achillea lanulosa	2	0.10	15.00	50	10	0.3	2.0
20. Erigeron speciosus	6	0.10	10.00	50	10	0.2	1.5
21. Chenopodium leptophyllum	6	0.05	5.00	50	5	0.2	4.0
22. Taraxacum officinale	2	0.05	5.00	50	5	0.5	3.0
All Species		25.55			2555		

*Value not recorded in the field because of sampling procedure or absence of species.
**Value cannot be calculated because of absence of data.

Table 3-7-9 Species encountered in the mature tree stratum in the Douglas fir type for RBOSP

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
OCTOBER 1974 (SUMMARY OF 6 TRANSECTS)						
1. *Pseudotsuga menziesii*	70.74	95.83	100	7074	514	23.00
2. *Populus tremuloides*	0.00	4.17	16	0	5	0.06
All Species	70.74			7074	519	23.00
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS)						
1. *Pseudotsuga menziesii*	53.77	100.00	100	5377	467	30.80
2. *Populus tremuloides*	0.60	4.00	20	60	3	0.52
All Species	54.37			5437	470	31.32

Table 3-7-10 Species encountered in the shrub-tree seedling stratum in the Douglas fir type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 6 TRANSECTS)										
1. Amelanchier sp.	*	*	*	19.59	95.83	100	1959	4555	*	**
2. Symphoricarpos oreophilus	*	*	*	10.78	87.50	100	1078	5144	*	**
3. Prunus virginiana	*	*	*	4.17	20.83	33	417	731	*	**
4. Pseudotsuga menziesii	*	*	*	3.17	87.50	100	317	435	*	**
5. Artemisia tridentata	*	*	*	0.51	12.50	17	51	139	*	**
6. Rosa woodsii	*	*	*	0.49	33.33	67	49	491	*	**
7. Quercus gambelii	*	*	*	0.40	12.50	17	40	593	*	**
8. Populus tremuloides	*	*	*	0.25	8.33	33	25	23	*	**
9. Acer glabrum	*	*	*	0.00	4.17	17	0	23	*	**
All Species				39.35			3935	12134		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS)										
1. Amelanchier utahensis	1	5	*	12.49	72.00	80	1249	1047	468	265,356
2. Symphoricarpos oreophilus	1	4	2, 7	10.98	100.00	100	1098	4597	<1	408
3. Prunus virginiana	1, 2	*	2	10.15	56.00	60	1015	1017	5	2,945
4. Pseudotsuga menziesii	2	2	2	7.87	100.00	100	787	1687	22	47,784
5. Amelanchier alnifolia	*	5	2, 7	6.75	24.00	40	675	310	*	**
6. Quercus gambelii	1	5	2	2.18	32.00	60	218	690	88	44,968
7. Ribes inerme	*	*	2	1.71	20.00	20	171	623	*	**
8. Acer glabrum	1	*	*	1.57	20.00	40	157	87	644	95,616
9. Rosa woodsii	1	4	2, 7	0.68	60.00	100	68	813	*	**
10. Pachystima myrsinites	*	*	2	0.49	4.00	20	49	1170	*	**
11. Ribes cereum	*	5	*	0.42	20.00	20	42	70	*	**
12. Purshia tridentata	*	*	2	0.34	4.00	20	34	10	*	**
13. Chrysothamnus nauseosus	*	3	*	0.07	4.00	20	7	3	*	**
14. Holodiscus dumosus	*	4	*	0.06	12.00	20	6	53	*	**
15. Mahonia repens	*	*	2	0.01	8.00	20	1	20	*	**
16. Sambucus coerulea	*	4, 5	*	0.00	8.00	20	0	7	*	**
17. Cercocarpus montanus	*	5	*	0.00	8.00	20	0	10	*	**
18. Artemisia tridentata	2	*	*	0.00	4.00	20	0	13	*	**
All Species				55.77			5577	12227		

Table 3-7-11 Species encountered in the herbaceous stratum in the Douglas fir type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 6 TRANSECTS)							
1. Carex geyeri	*	18.69	90.00	100	1869	*	**
2. Pachystima myrsinites	*	0.80	15.00	83	80	*	**
3. Galium boreale	*	0.53	25.00	83	53	*	**
4. Aster sp.	*	0.49	13.00	33	49	*	**
5. Thermopsis montana	*	0.15	3.33	17	15	*	**
6. Erigeron sp.	*	0.08	3.33	33	8	*	**
7. Smilacina sp.	*	0.08	1.67	17	8	*	**
8. Bromus marginatus	*	0.06	5.00	17	6	*	**
9. Astragalus sp.	*	0.06	6.67	17	6	*	**
10. Agropyron smithii	*	0.04	3.33	17	4	*	**
11. Poa sp.	*	0.03	3.33	33	3	*	**
12. Achillea lanulosa	*	0.03	1.67	17	3	*	**
13. Thalictrum fendleri	*	0.03	1.67	17	3	*	**
14. Angelica sp.	*	0.01	1.67	17	1	*	**
15. Mahonia repens	*	0.01	1.67	17	1	*	**
16. Unknown Compositae	*	0.36	6.67	33	36	*	**
All Species		21.45			2145		
MAY-JUNE 1975 (SUMMARY OF 2 TRANSECTS)							
1. Carex geyeri	2	7.08	85.00	100	708	*	**
2. Pachystima myrsinites	2	1.30	35.00	50	130	*	**
3. Mahonia repens	2	0.15	10.00	100	15	*	**
4. Achillea lanulosa	2	0.00	5.00	50	0	*	**
5. Astragalus sp.	2	0.00	5.00	50	0	*	**
6. Bromus sp.	2	0.00	5.00	50	0	*	**
7. Carex sp.	2	0.00	5.00	50	0	*	**
8. Lithospermum ruderale	1	0.00	5.00	50	0	*	**
9. Viola sp.	2	0.00	5.00	50	0	*	**
All Species		8.53			853		

Table 3-7-11 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 2 TRANSECTS)							
1. Carex geyeri	2	10.35	95.00	100	1035	*	**
2. Thalictrum fendleri	2	3.20	20.00	100	320	3.0	14.8
3. Astragalus tenellus	2	1.80	30.00	50	180	1.2	4.0
4. Osmorhiza depauperata	2	1.10	20.00	50	110	1.1	5.5
5. Vicia americana	7	1.10	20.00	50	110	1.0	5.0
6. Solidago sp.	2	1.10	10.00	50	110	1.2	12.0
7. Galium boreale	2	0.70	35.00	100	70	1.7	4.9
8. Achillea lanulosa	2	0.55	10.00	100	55	0.7	7.0
9. Aquilegia caerulea	3	0.50	5.00	50	50	0.2	3.0
10. Viola adunca	2	0.45	25.00	50	45	0.5	1.8
11. Stipa columbiana	5	0.30	10.00	50	30	*	**
12. Chenopodium fremontii	2	0.30	5.00	50	30	0.5	10.00
13. Erigeron speciosus	2	0.20	15.00	50	20	0.2	1.3
14. Lithospermum ruderale	6	0.20	5.00	50	20	0.1	2.0
15. Smilacina stellata	5	0.20	5.00	50	20	0.1	1.0
16. Agropyron trachycaulum	4	0.15	5.00	50	15	*	1.0
17. Helianthella uniflora	2	0.10	5.00	50	10	0.2	**
18. Mahonia repens	2	0.10	5.00	50	10	0.1	3.0
19. Thermopsis montana	2	0.10	5.00	50	10	0.1	1.0
20. Bromus marginatus	4	0.05	10.00	50	5	*	**
21. Crepis acuminata	2	0.05	5.00	50	5	0.1	1.0
22. Koeleria gracilis	2	0.05	5.00	50	5	*	**
23. Taraxacum officinale	2	0.05	5.00	50	5	0.1	3.0
All Species		22.70			2270		
SEPTEMBER 1975 (SUMMARY OF 2 TRANSECTS)							
1. Carex geyeri	2	9.55	95.00	100	955	*	**
2. Thalictrum fendleri	2	1.40	20.00	100	140	2.0	9.8
3. Erigeron speciosus	2	0.90	20.00	100	90	1.6	7.8
4. Astragalus tenellus	2	0.70	30.00	50	70	0.9	2.8
5. Galium boreale	2	0.30	15.00	100	30	1.4	9.3
6. Lithospermum ruderale	2	0.30	5.00	50	30	0.1	1.0
7. Osmorhiza depauperata	2	0.25	10.00	50	25	0.5	4.5
8. Agropyron trachycaulum	2	0.20	15.00	50	20	*	**

Table 3-7-11 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
			SEPTEMBER 1975 (SUMMARY OF 2 TRANSECTS) CONTINUED				
9. Achillea lanulosa	2	0.15	10.00	100	15	0.5	5.0
10. Viola nuttallii	2	0.15	10.00	50	15	0.4	3.5
11. Viola pallens	2	0.15	10.00	50	15	0.2	2.0
12. Vicia americana	2	0.15	5.00	50	15	0.2	3.0
13. Bromus marginatus	2	0.10	10.00	50	10	*	**
14. Smilacina stellata	7	0.10	5.00	50	10	0.1	1.0
15. Stipa comata	7	0.05	5.00	50	5	*	**
16. Aquilegia caerulea	8	0.05	5.00	50	5	0.1	1.0
17. Viola sp.	2	0.05	5.00	50	5	0.1	2.0
18. Stipa columbiana	2	0.00	5.00	50	0	*	**
All Species		14.55			1455		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-12 Species encountered in the mature tree stratum in the mixed brush type for RBOSP.

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 17 TRANSECTS)						
1. *Pinus edulis*	0.10	2.35	12	10	2	0.03

Table 3-7-13 Species encountered in the shrub-tree seedling stratum in the mixed brush type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology			Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
	May-June	July	September							
OCTOBER 1974 (SUMMARY OF 13 TRANSECTS)										
1. Amelanchier utahensis	*	*	*	16.72	100.00	100	1672	4391	*	**
2. Artemisia tridentata	*	*	*	12.60	94.23	100	1260	5782	*	**
3. Symphoricarpos oreophilus	*	*	*	7.26	98.08	100	726	4637	*	**
4. Quercus gambelii	*	*	*	2.09	11.54	15	209	312	*	**
5. Chrysothamnus viscidiflorus	*	*	*	0.77	67.31	77	77	1100	*	**
6. Purshia tridentata	*	*	*	0.58	34.62	54	58	340	*	**
7. Cercocarpus montanus	*	*	*	0.47	15.38	31	47	147	*	**
8. Pinus edulis	*	*	*	0.04	32.69	46	4	49	*	**
9. Chrysothamnus nauseosus	*	*	*	0.03	11.54	15	3	24	*	**
10. Juniperus osteosperma	*	*	*	0.00	17.31	38	0	26	*	**
11. Tetradymia canescens	*	*	*	0.00	7.69	15	0	17	*	**
12. Pseudotsuga menziesii	*	*	*	0.00	1.92	8	0	4		
All Species				40.56			4056	16829		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 17 TRANSECTS)										
1. Amelanchier utahensis	2,3,4	5	2	30.36	97.65	100	3036	2902	235.92	86503
2. Symphoricarpos oreophilus	1,2	4	2	12.24	96.47	100	1224	4100	2.31	569
3. Artemisia tridentata	2	3	5,6	7.84	85.88	94	784	3653	0.18	22
4. Quercus gambelii	1,2	5	6	4.16	18.82	29	416	279	135.90	8607
5. Purshia tridentata	2	*	2	1.63	34.12	47	163	403	.42	23
6. Prunus virginiana	2,3	5	*	1.12	15.29	29	112	185	.01	0
7. Chrysothamnus viscidiflorus	2	2,3	6	.46	55.29	88	46	1017	.00	0
8. Tetradymia canescens	2	*	2	.13	17.65	41	13	417	.00	0
9. Rosa woodsii	*	4	*	.12	5.88	12	12	*	*	**
10. Pinus edulis	*	*	*	.10	16.47	23	10	40	8.18	27
11. Chrysothamnus nauseosus	2	3	*	.08	5.88	12	8	24	.00	0
12. Gutierrizia sarothrae	*	*	5	.01	5.88	6	1	23	*	**
13. Juniperus osteosperma	2	*	2	.00	5.88	12	0	6	.00	*
14. Ceanothus martini	2,3	*	*	.00	1.18	6	0	26	.00	0
15. Opuntia polyacantha	*	*	2	.00	2.35	6	0	2	*	*

Table 3-7-13 (Continued)

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 17 TRANSECTS) (CONTINUED)										
16. Ribes inerme	*	5,6	*	.00	3.53	18	0	5	*	**
17. Populus tremuloides	*	2	*	.00	2.35	6	0	4	*	**
18. Amelanchier alnifolia	*	5	*	.00	1.18	6	0	11	*	**
19. Cercocarpus montanus	*	5	*	.00	1.18	6	0	1	*	**
20. Pseudotsuga menziesii	*	*	*	.00	1.18	6	0	1		
All Species				58.25			5825	13116		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-14 Species encountered in the herbaceous stratum in the mixed brush for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 13 TRANSECTS)							
1. Carex geyeri	*	8.79	33.08	62	879	*	**
2. Poa sandbergii	*	2.64	21.54	54	264	*	**
3. Poa sp.	*	2.13	27.69	54	213	*	**
4. Eriogonum sp.	*	1.08	16.15	31	108	*	**
5. Agropyron trachycaulum	*	0.91	20.77	54	91	*	**
6. Lupinus sp.	*	0.83	15.38	46	83	*	**
7. Phlox hoodii	*	0.80	10.77	31	80	*	**
8. Eriogonum umbellatum	*	0.56	10.00	38	56	*	**
9. Penstemon caespitosus	*	0.49	11.54	38	49	*	**
10. Pachystima myrsinites	*	0.43	2.31	15	43	*	**
11. Erigeron sp.	*	0.42	19.23	62	42	*	**
12. Agropyron smithii	*	0.35	9.23	23	35	*	**
13. Koeleria gracilis	*	0.23	6.93	8	23	*	**
14. Stipa comata	*	0.23	2.31	8	23	*	**
15. Bromus marginatus	*	0.21	5.38	23	21	*	**
16. Agropyron spicatum	*	0.18	3.85	8	18	*	**
17. Geranium richardsonii	*	0.11	3.85	8	11	*	**
18. Astragalus sp.	*	0.08	5.38	15	8	*	**
19. Oryzopsis hymenoides	*	0.06	4.62	8	6	*	**
20. Achillea lanulosa	*	0.06	3.85	23	6	*	**
21. Stipa sp.	*	0.06	3.85	15	6	*	**
22. Hedysarum boreale	*	0.06	2.31	8	6	*	**
23. Thalictrum fendleri	*	0.04	0.77	8	4	*	**
24. Haplopappus nuttallii	*	0.03	3.08	23	3	*	**
25. Galium boreale	*	0.03	2.31	23	3	*	**
26. Ipomopsis sp.	*	0.03	1.54	15	3	*	**
27. Frasera speciosa	*	0.03	0.77	8	3	*	**
28. Phlox sp.	*	0.03	0.77	8	3	*	**
29. Muhlenbergia sp.	*	0.02	1.54	15	2	*	**
30. Oxytropis lambertii	*	0.02	0.77	8	2	*	**

Table 3-7-14 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
			OCTOBER 1974 (SUMMARY OF 13 TRANSECTS) CONTINUED				
31. Solidago sp.	*	0.01	1.54	15	1	*	**
32. Antennaria sp.	*	0.01	0.77	8	1	*	**
33. Senecio sp.	*	0.01	0.77	8	1	*	**
34. Sitanion longifolium	*	0.01	0.77	8	1	*	**
35. Gutierrezia sarothrae	*	0.00	0.77	8	0	*	**
36. Physaria florbunda	*	0.00	0.77	8	0	*	**
37. Unknown Compositae	*	0.22	7.69	38	22	*	**
38. Unknown Boraginaceae	*	0.12	0.77	8	12	*	**
39. Unknown Crucifereae	*	0.05	3.85	15	5	*	**
40. Unknown Umbellifereae	*	0.02	0.77	8	2	*	**
All Species		21.39			2139		
			MAY-JUNE 1975 (SUMMARY OF 5 TRANSECTS)				
1. Carex geyeri	2,3,4	1.96	30.00	60	196	*	**
2. Oryzopsis hymenoides	2	0.52	28.00	80	52	*	**
3. Haplopappus nuttallii	2	0.32	20.00	40	32	*	**
4. Agropyron trachycaulum	2	0.30	20.00	60	30	*	**
5. Penstemon caespitosus	2,3	0.22	18.00	80	22	*	**
6. Koeleria gracilis	2	0.20	22.00	40	20	*	**
7. Mahonia repens	3	0.16	10.00	20	16	*	**
8. Stipa sp.	2	0.12	10.00	20	12	*	**
9. Cryptantha sericea	3	0.12	4.00	20	12	*	**
10. Linum lewisii	2,3	0.10	10.00	40	10	*	**
11. Balsamorhiza sagittata	1	0.10	4.00	20	10	*	**
12. Poa sandbergii	2	0.08	8.00	40	8	*	**
13. Eriogonum umbellatum	2	0.08	6.00	60	8	*	**
14. Osmorhiza depauperata	3,4	0.08	4.00	20	8	*	**
15. Eriogonum ovalifolium	2	0.06	6.00	20	6	*	**
16. Lupinus sp.	2	0.06	6.00	20	6	*	**
17. Clematis hirsutissima	3,4	0.06	4.00	20	6	*	**
18. Gutierrezia sarothrae	2	0.04	4.00	20	4	*	**
19. Achillea lanulosa	2	0.04	2.00	20	4	*	**
20. Physaria floribunda	2,4	0.02	10.00	40	2	*	**
21. Agropyron smithii	2	0.02	4.00	40	2	*	**
22. Frasera sp.	2	0.02	4.00	20	2	*	**
23. Ipomopsis sp.	2	0.02	4.00	20	2	*	**

Table 3-7-14 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
			MAY-JUNE 1975 (SUMMARY OF 5 TRANSECTS CONTINUED				
24. Solidago sp.	2	0.02	4.00	40	2	*	**
25. Aster sp.	2	0.02	2.00	20	2	*	**
26. Eriogonum sp.	2	0.02	2.00	20	2	*	**
27. Lithospermum ruderale	2,3,4	0.02	2.00	20	2	*	**
28. Senecio integerrimus	3	0.02	2.00	20	2	*	**
29. Collinsia parviflora	3,4	0.01	14.00	60	1	*	**
30. Poa sp.	2	0.01	12.00	40	1	*	**
31. Crepis acuminata	2	0.01	4.00	40	1	*	**
32. Erigeron sp.	2	0.00	14.00	40	0	*	**
33. Antennaria sp.	2	0.00	8.00	40	0	*	**
34. Delphinium nelsonii	2,3	0.00	8.00	40	0	*	**
35. Astragalus sp.	2,3,4	0.00	4.00	40	0	*	**
36. Taraxacum officinale	2	0.00	4.00	20	0	*	**
37. Bromus marginatus	2	0.00	2.00	20	0	*	**
38. Circium arvense	2	0.00	2.00	20	0	*	**
39. Cryptantha sericea	2	0.00	2.00	20	0	*	**
40. Cymopterus sp.	3	0.00	2.00	20	0	*	**
41. Galium boreale	2	0.00	2.00	20	0	*	**
42. Lappula redowskii	3	0.00	2.00	20	0	*	**
43. Phlox longifolia	2,3,4	0.00	2.00	20	0	*	**
44. Trifolium gymnocarpon	2	0.00	2.00	20	0	*	**
45. Unknown	*	0.08	6.00	**	8	*	**
All Species		4.91			491		
			JULY 1975 (SUMMARY OF 5 TRANSECTS)				
1. Carex geyeri	2	2.50	32.00	40	250	*	**
2. Eriogonum umbellatum	2,6	1.08	16.00	60	108	1.3	7.9
3. Oryzopsis hymenoides	2,6,5	0.98	28.00	80	98	*	**
4. Stipa comata	7	0.98	10.00	20	98	*	**
5. Poa sandbergii	2	0.90	16.00	20	90	*	**
6. Agropyron trachycaulum	2,4	0.64	32.00	60	64	*	**
7. Haplopappus nuttallii	4	0.64	22.00	40	64	0.8	3.5
8. Penstemon caespitosus	2	0.54	26.00	60	54	0.9	3.3
9. Gutierrezia sarothrae	3,5,6	0.52	6.00	40	52	0.5	8.3
10. Mahonia repens	6,2	0.38	14.00	40	38	0.5	3.5

Table 3-7-14 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
			JULY 1975 (SUMMARY OF 5 TRANSECTS) CONTINUED				
11. Linum lewisii	2,4,5	0.26	20.00	60	26	0.7	3.3
12. Koeleria gracilis	6,5	0.26	10.00	40	26	*	**
13. Cryptantha sericea	2,7	0.20	26.00	80	20	0.5	1.9
14. Comandra umbellata	2	0.16	8.00	20	16	0.6	7.0
15. Crepis acuminata	6,2	0.12	6.00	60	12	0.1	2.0
16. Pachystima myrsinites	2	0.12	4.00	20	12	0.1	3.0
17. Angelica ampla	2,7	0.10	6.00	20	10	0.1	2.0
18. Lupinus caudatus	2	0.10	6.00	20	10	0.1	1.3
19. Balsamorhiza sagittata	6,7	0.10	2.00	20	10	0.0	1.0
20. Physaria floribunda	2,5	0.08	10.00	40	8	0.2	2.0
21. Erigeron pumilus	6	0.06	8.00	20	6	0.1	1.3
22. Galium boreale	4	0.06	6.00	20	6	0.3	5.0
23. Penstemon sp.	4	0.06	4.00	20	6	0.1	2.0
24. Heuchera parvifolia	6	0.06	4.00	20	6	0.0	1.0
25. Ipomopsis aggregata	4	0.06	4.00	20	6	0.0	1.0
26. Hedysarum boreale	6	0.06	2.00	20	6	0.0	2.0
27. Clematis hirsutissima	6	0.06	2.00	20	6	0.0	1.0
28. Elymus cinereus	2	0.06	2.00	20	6	*	**
29. Astragalus diversifolius	2,5	0.04	6.00	40	4	0.1	2.0
30. Erysimum asperum	7	0.04	2.00	20	4	0.1	3.0
31. Lithospermum ruderale	6	0.04	2.00	20	4	0.0	1.0
32. Bromus tectorum	7	0.02	4.00	20	2	0.1	2.5
33. Astragalus chamaeleuce	2	0.02	2.00	20	2	0.1	5.0
34. Antennaria pulcherrima	6	0.02	2.00	20	2	0.0	1.0
35. Circium sp.	2	0.02	2.00	20	2	0.0	1.0
36. Sphaeralcea coccinea	2	0.02	2.00	20	2	0.0	1.0
37. Phlox longifolia	7,2	0.00	12.00	60	0	0.2	1.7
38. Collinsia parviflora	6,7,5	0.00	10.00	40	0	0.3	3.2
39. Chenopodium fremontii	2	0.00	4.00	20	0	0.1	2.0
40. Achillea lanulosa	2	0.00	2.00	20	0	0.1	4.0
41. Agoseris glauca	2	0.00	2.00	20	0	0.0	1.0
42. Agropyron smithii	2	0.00	2.00	20	0	*	**

Table 3-7-14 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 5 TRANSECTS) CONTINUED							
43. Bromus marginatus	2	0.00	2.00	20	0	*	**
44. Carex sp.	2	0.00	2.00	20	0	*	**
45. Erigeron eatonii	2	0.00	2.00	20	0	0.0	1.0
46. Poa sp.	2	0.00	2.00	20	0	**	**
All Species		11.36			1136		
SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS)							
1. Carex geyeri	2	2.66	30.00	60	266	*	**
2. Poa sandbergii	2	0.72	22.00	40	72	*	**
3. Oryzopsis hymenoides	2,7	0.62	28.00	100	62	*	**
4. Haplopappus nuttallii	7,2	0.62	22.00	40	62	0.9	4.0
5. Penstemon caespitosus	2	0.48	26.00	80	48	1.0	3.7
6. Stipa comata	7	0.46	10.00	40	46	*	**
7. Senecio canus	2	0.40	12.00	20	40	1.1	8.8
8. Agropyron trachycaulum	2	0.34	24.00	80	34	*	**
9. Linum lewisii	2	0.14	16.00	40	14	0.5	3.1
10. Cryptantha sericea	2	0.12	20.00	80	12	0.4	2.0
11. Koeleria gracilis	2	0.12	12.00	40	12	*	**
12. Castilleja chromosa	2	0.08	6.00	20	8	0.1	1.0
13. Helianthella uniflora	4	0.08	6.00	20	8	0.1	1.0
14. Eriogonum umbellatum	2	0.08	4.00	40	8	0.1	2.0
15. Balsamorhiza saggittata	8	0.08	2.00	20	8	0.0	1.0
16. Elymus cinereus	2	0.08	2.00	20	8	*	**
17. Erigeron eatonii	8,2	0.06	4.00	20	6	0.2	2.2
18. Ipomopsis aggregata	6	0.06	4.00	20	6	0.0	1.0
19. Physaria floribunda	3,2	0.04	8.00	40	4	0.2	2.0
20. Galium boreale	2	0.04	6.00	20	4	0.2	2.7
21. Astragalus diversifolius	2,8	0.04	6.00	40	4	0.1	2.3
22. Comandra umbellata	2	0.04	6.00	20	4	0.1	1.7
23. Lithospermum ruderale	7	0.04	2.00	20	4	0.0	2.0

Table 3-7-14 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS) CONTINUED							
24. *Clematis hirsutissima*	8	0.04	2.00	20	4	0.0	1.0
25. *Polygonum sawatchense*	6	0.02	2.00	20	2	0.1	7.0
26. *Achillea lanulosa*	2	0.02	2.00	20	2	0.1	3.0
27. *Penstemon fremontii*	7	0.02	2.00	20	2	0.0	2.0
28. *Erysimum asperum*	8	0.02	2.00	20	2	0.0	1.0
29. *Hedysarum boreale*	2	0.02	2.00	20	2	0.0	1.0
30. *Heuchera parvifolia*	2	0.02	2.00	20	2	0.0	1.0
31. *Lupinus caudatus*	8	0.02	2.00	20	2	0.0	1.0
32. *Sitanion longifolium*	8	0.02	2.00	20	2	*	**
33. *Sphaeralcea coccinea*	2	0.02	2.00	20	2	0.0	1.0
34. *Chenopodium leptophyllum*	2	0.00	2.00	20	0	0.1	3.0
All Species		7.62			762		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-15 Species encountered in the shrub stratum of the serviceberry-oak and serviceberry-snowberry mixed brush associations for RBOSP

Species	Percent Cover	Percent Frequency	Density #/ha
SERVICEBERRY-OAK MIXED BRUSH			
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 6 TRANSECTS)			
1. *Amelanchier utahensis*	39.17	100.00	3250
2. *Symphoricarpos oreophilus*	12.92	100.00	4700
3. *Quercus gambelii*	11.78	53.33	792
4. *Artemisia tridentata*	8.00	98.00	4739
5. *Purshia tridentata*	3.86	43.33	950
6. *Prunus virginiana*	3.18	43.33	525
7. *Cercocarpus montanus*	0.44	3.33	8
8. *Rosa woodsii*	0.36	23.33	53
9. *Chrysothamnus viscidiflorus*	0.08	40.00	381
10. *Tetradymia canescens*	0.03	3.33	25
11. *Populus tremuloides*	0.00	6.67	11
12. *Amelanchier alnifolia*	0.00	3.33	31
13. *Ribes inerme*	0.00	3.33	8
All Species	79.82		15,473
SERVICEBERRY-SNOWBERRY MIXED BRUSH			
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 11 TRANSECTS)			
1. *Amelanchier utahensis*	25.57	96.36	2712
2. *Symphoricarpos oreophilus*	11.87	94.55	3773
3. *Artemisia tridentata*	7.74	83.64	3061
4. *Cercocarpus montanus*	2.07	21.82	368
5. *Chrysothamnus viscidiflorus*	0.64	63.64	1364
6. *Purshia tridentata*	0.41	29.09	105
7. *Tetradymia canescens*	0.19	25.45	630
8. *Pinus edulis*	0.16	25.45	62
9. *Chrysothamnus nauseosus*	0.12	9.09	36
10. *Gutierrezia sarothrae*	0.01	9.09	35
11. *Juniperus osteosperma*	0.00	9.09	9
12. *Opuntia polyacantha*	0.00	3.64	3
13. *Ribes inerme*	0.00	3.64	3
14. *Ceanothus martini*	0.00	1.82	41
15. *Pseudotsuga menziesii*	0.00	1.82	2
All Species	48.78		12,204

*Value not recorded in the field because of sampling procedure or absence of species.

Table 3-7-16 Species encountered in the herbaceous stratum of the serviceberry-oak and serviceberry-snowberry mixed brush associations for RBOSP

Species	Percent Cover	Percent Frequency	Density #/quad. (.5m^2)
SERVICEBERRY-OAK MIXED BRUSH			
JULY 1975 (SUMMARY OF 2 TRANSECTS)			
1. *Carex geyeri*	6.25	80.00	*
2. *Oryzopsis hymenoides*	0.90	20.00	*
3. *Comandra umbellata*	0.40	20.00	2.8
4. *Eriogonum umbellatum*	0.35	10.00	0.3
5. *Agropyron trachycaulum*	0.25	20.00	*
6. *Angelica ampla*	0.25	15.00	0.5
7. *Galium boreale*	0.15	15.00	1.5
8. *Penstemon* sp.	0.15	10.00	0.4
9. *Ipomopsis aggregata*	0.15	10.00	0.2
10. *Penstemon caespitosus*	0.15	10.00	0.2
	9.00		5.9
Total Number of Herbaceous Species 23			
Total Cover of Herbaceous Species	26.34		
SERVICEBERRY-SNOWBERRY MIXED BRUSH			
JULY 1975 (SUMMARY OF 3 TRANSECTS)			
1. *Stipa comata*	1.63	16.67	*
2. *Eriogonum umbellatum*	1.57	20.00	4.0
3. *Poa sandbergii*	1.50	26.67	*
4. *Haplopappus nuttallii*	1.07	36.67	2.5
5. *Oryzopsis hymenoides*	1.03	33.33	*
6. *Agropyron trachycaulum*	0.90	40.00	*
7. *Penstemon caespitosus*	0.80	36.67	2.7
8. *Koeleria gracilis*	0.43	16.67	*
9. *Linum lewisii*	0.43	33.33	2.2
10. *Cryptantha sericea*	0.30	36.67	1.3
	9.66		12.7
Total Number of Herbaceous Species 29			
Total Cover of Herbaceous Species	11.00		

*Value not recorded in the field because of sampling procedure or absence of species.

Table 3-7-17 Species encountered in the mature tree stratum of the serviceberry-snowberry mixed brush association for RBOSP

Species	Percent Cover	Percent Frequency	Density #/ha	Constancy	Basal Area
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 11 TRANSECTS)					
1. Pinus edulis	0.16	3.64	3.03	18	.04

Table 3-7-18 Species encountered in the mature tree stratum in the pinyon-juniper type for RBOSP

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
OCTOBER 1974 (SUMMARY OF 26 TRANSECTS)						
1. *Juniperus osteosperma*	14.02	69.23	--	1402	224	30.47
2. *Pinus edulis*	8.85	43.27	--	885	85	8.26
All Species	22.87			2287	309	38.73
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 25 TRANSECTS)						
1. *Pinus edulis*	11.50	59.00	88	1150	111	14.33
2. *Juniperus osteosperma*	9.73	73.60	88	973	143	22.73
All Species	21.23			2123	254	37.06

Table 3-7-19 Species encountered in the shrub-tree seedling stratum in the pinyon-juniper type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology			Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
	May-June	July	September							
OCTOBER 1974 (SUMMARY OF 26 TRANSECTS)										
1. Artemisia tridentata	*	*	*	4.11	84.62	100	411	2519	*	**
2. Pinus edulis	*	*	*	0.88	62.50	80	88	245	*	**
3. Cercocarpus montanus	*	*	*	0.69	14.42	23	69	64	*	**
4. Amelanchier utahensis	*	*	*	0.65	22.12	38	65	216	*	**
5. Purshia tridentata	*	*	*	0.58	24.04	50	58	76	*	**
6. Atriplex confertifolia	*	*	*	0.44	8.65	23	43	123	*	**
7. Juniperus osteosperma	*	*	*	0.27	33.65	69	27	75	*	**
8. Symphoricarpos oreophilus	*	*	*	0.21	12.50	23	21	65	*	**
9. Chrysothamnus sp.	*	*	*	0.16	13.46	23	15	75	*	**
10. Chrysothamnus viscidiflorus	*	*	*	0.12	16.35	38	12	156	*	**
11. Chrysothamnus nauseosus	*	*	*	0.10	18.27	19	10	118	*	**
12. Tetradymia canescens	*	*	*	0.04	2.88	8	4	21	*	**
13. Eurotia lanata	*	*	*	0.00	1.92	4	0	7	*	**
14. Ephedra viridis	*	*	*	0.00	0.96	4	0	1	*	**
15. Sorbus scopulina	*	*	*	0.00	0.96	4	0	1	*	**
All Species				8.25			825	3762		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 25 TRANSECTS)										
1. Artemisia tridentata	2,3	3	4,5	4.69	84.80	100	469	1670	.08	142
2. Amelanchier utahensis	2,3,4	5	7	2.50	40.00	64	250	450	.40	140
3. Purshia tridentata	2,3,5	5	2,7	.94	42.40	60	94	230	.03	7
4. Pinus edulis	2	2	2	.90	69.60	92	90	281	.36	101
5. Cercocarpus montanus	2,3	5	2,7	.55	25.60	40	55	157	.19	21
6. Chrysothamnus viscidiflorus	2	3	4,5	.39	41.60	56	39	314	.08	15
7. Symphoricarpos oreophilus	2	2,4	7	.21	22.40	44	21	151	.03	2
8. Juniperus osteosperma	2	2	2	.17	37.60	72	17	79	.06	5
9. Atriplex confertifolia	2	*	2	.06	7.20	16	6	30	.14	2

Table 3-7-19 (Continued)

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 25 TRANSECTS) (CONTINUED)										
10. *Opuntia polyacantha*	2	4,5	2	.05	19.20	52	5	42	.0	**
11. *Gutierrèzia sarothrae*	*	*	4,5	.04	13.60	20	4	148	*	**
12. *Chrysothamnus nauseosus*	2	3	4,5	.03	16.80	48	3	82	.00	**
13. *Tetradymia canescens*	2	*	2	.03	12.80	40	3	59	.01	**
14. *Opuntia fragilis*	2	4,5	*	.01	7.20	12	1	25	.00	**
15. *Artemisia frigida*	*	*	5,6	.00	3.20	4	0	11	*	**
16. *Ephedra viridis*	*	*	2	.00	1.60	4	0	5	*	**
17. *Eurotia lanata*	*	*	5,6	.00	2.40	4	0	11		
All Species				10.57			1057	3745		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-20 Species encountered in the herbaceous stratum in the pinyon-juniper type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 26 TRANSECTS)							
1. Poa sandbergii	*	0.98	23.85	50	98	*	**
2. Agropyron trachycaulum	*	0.86	27.69	69	86	*	**
3. Poa sp.	*	0.48	12.31	30	48	*	**
4. Oryzopsis hymenoides	*	0.28	11.92	50	28	*	**
5. Cryptantha sericea	*	0.24	9.23	38	24	*	**
6. Carex sp.	*	0.23	4.62	12	23	*	**
7. Phlox hoodii	*	0.22	8.08	26	22	*	**
8. Haplopappus nuttallii	*	0.21	22.31	50	21	*	**
9. Gutierrezia sarothrae	*	0.20	7.69	31	20	*	**
10. Arenaria sp.	*	0.13	6.92	31	13	*	**
11. Eriogonum sp.	*	0.10	6.15	19	10	*	**
12. Koeleria gracilis	*	0.09	9.62	4	9	*	**
13. Mentzelia sp.	*	0.09	1.54	8	9	*	**
14. Bouteloua gracilis	*	0.08	1.15	8	8	*	**
15. Penstemon caespitosus	*	0.08	3.46	15	8	*	**
16. Moss	*	0.07	0.38	4	7	*	**
17. Agropyron smithii	*	0.06	2.69	12	6	*	**
18. Lithospermum sp.	*	0.06	2.31	12	6	*	**
19. Phlox sp.	*	0.05	3.85	15	5	*	**
20. Sitanion longifolium	*	0.04	5.00	31	4	*	**
21. Chenopodium sp.	*	0.04	1.92	12	4	*	**
22. Erigeron sp.	*	0.04	6.15	31	4	*	**
23. Physaria floribunda	*	0.03	8.08	46	3	*	**
24. Agropyron spicatum	*	0.03	0.77	4	3	*	**
25. Aster sp.	*	0.02	1.54	15	2	*	**
26. Penstemon sp.	*	0.01	2.69	15	1	*	**
27. Lupinus sp.	*	0.01	1.54	8	1	*	**
28. Eriogonum umbellatum	*	0.01	1.15	12	1	*	**
29. Stipa sp.	*	0.01	1.15	8	1	*	**
30. Antennaria sp.	*	0.01	0.77	4	1	*	**

Table 3-7-20 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS) CONTINUED							
31. Euphorbia sp.	*	0.01	0.38	4	1	*	**
32. Mahonia repens	*	0.01	0.38	4	1	*	**
33. Oenothera sp.	*	0.01	0.38	4	1	*	**
34. Plantago sp.	*	0.01	0.38	4	1	*	**
35. Astragalus sp.	*	0.00	1.15	8	0	*	**
36. Chaenactis sp.	*	0.00	0.77	8	0	*	**
37. Descurania sp.	*	0.00	0.77	8	0	*	**
38. Lepidium sp.	*	0.00	0.77	4	0	*	**
39. Cirsium sp.	*	0.00	0.77	4	0	*	**
40. Balsamorhiza sagittata	*	0.00	0.38	4	0	*	**
41. Bromus tectorum	*	0.00	0.38	4	0	*	**
42. Unknown Compositae	*	0.21	4.62	12	21	*	**
43. Unknown Gramineae	*	0.11	1.92	8	11	*	**
44. Unknown Baraginaceae	*	0.03	1.54	4	3	*	**
45. Unknown Cruciferae	*	0.01	2.31	23	1	*	**
All Species		5.16			5.6		
MAY-JUNE 1975 (SUMMARY OF 7 TRANSECTS)							
1. Agropyron trachycaulum	2	0.46	48.57	100	46	*	**
2. Oryzopsis hymenoides	2	0.31	28.57	71	31	*	**
3. Poa sandbergii	2	0.29	17.14	57	29	*	**
4. Phlox hoodii	2	0.22	25.71	71	22	*	**
5. Stipa sp.	2	0.21	11.43	29	21	*	**
6. Koeleria gracilis	2	0.15	21.43	57	15	*	**
7. Haplopappus nuttallii	2	0.11	18.57	71	11	*	**
8. Poa sp.	2	0.11	15.71	57	11	*	**
9. Antennaria sp.	2	0.10	15.71	57	10	*	**
10. Cryptantha sericea	2	0.02	5.71	14	2	*	**
11. Poa fendleriana	2	0.07	1.43	14	7	*	**
12. Carex geyeri	2	0.06	4.29	29	6	*	**
13. Eriogonum sp.	3,2	0.05	4.29	14	5	*	**
14. Sitanion longifolium	2	0.04	10.00	57	4	*	**
15. Eriogonum umbellatum	2	0.04	2.86	14	4	*	**

Table 3-7-20 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
MAY-JUNE 1975 (SUMMARY OF 7 TRANSECTS) CONTINUED							
16. *Festuca* sp.	2	0.02	5.71	14	2	*	**
17. *Agropyron smithii*	2	0.01	2.86	29	1	*	**
18. *Balsamorhiza sagittata*	2	0.01	1.43	14	1	*	**
19. *Lomatium* sp.	4,5	0.01	1.43	14	1	*	**
20. *Trifolium gymnocarpon*	2,3	0.00	8.57	29	0	*	**
21. *Physaria floribunda*	4,2,3	0.00	5.71	43	0	*	**
22. *Chaenactis douglass*	2	0.00	4.29	14	0	*	**
23. *Cymopterus* sp.	2	0.00	4.29	29	0	*	**
24. *Sisymbrium* sp.	2,3	0.00	4.29	29	0	*	**
25. *Sphaeralcea coccinea*	2	0.00	4.29	14	0	*	**
26. *Arenaria* sp.	2,3	0.00	2.86	14	0	*	**
27. *Descurainia pinnata*	3	0.00	2.86	14	0	*	**
28. *Agoseris glauca*	2	0.00	1.43	14	0	*	**
29. *Agoseris* sp.	2	0.00	1.43	14	0	*	**
30. *Androsace septentrionalis*	2	0.00	1.43	14	0	*	**
31. *Astragalus* sp.	3,2	0.00	1.43	14	0	*	**
32. *Carex* sp.	2	0.00	1.43	14	0	*	**
33. *Chenopodium fremontii*	2	0.00	1.43	14	0	*	**
34. *Crepis* sp.	2	0.00	1.43	14	0	*	**
35. *Delphinium* sp.	2	0.00	1.43	14	0	*	**
36. *Euphorbia* sp.	2	0.00	1.43	14	0	*	**
37. *Gutierrezia sarothrae*	2	0.00	1.43	14	0	*	**
38. *Lappula redowskii*	3	0.00	1.43	14	0	*	**
39. *Penstemon* sp.	2	0.00	1.43	14	0	*	**
40. *Phlox longifolia*	2	0.00	1.43	14	0	*	**
41. *Phlox multiflora*	4,2,3	0.00	1.43	14	0	*	**
42. *Senecio* sp.	2	0.00	1.43	14	0	*	**
43. Unknown Compositae	2	0.00	1.43	14	0	*	**
44. Unknown	*	0.00	2.86	**	0	*	**
All Species		2.29			229		

Table 3-7-20 (Continued)

Species	Phenology	Percent Cover	Percent Frequency,	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 7 TRANSECTS)							
1. Agropyron trachycaulum	2	1.01	47.14	86	101	*	**
2. Poa sandbergii	2	0.71	12.86	71	71	*	**
3. Oryzopsis hymenoides	2,6,5	0.53	28.57	86	53	*	**
4. Koeleria gracilis	2	0.43	14.29	43	43	*	**
5. Stipa comata	7,5,2	0.41	14.29	57	41	*	**
6. Agropyron smithii	4,2	0.37	15.71	71	37	*	**
7. Phlox hoodii	2	0.34	30.00	86	34	0.2	1.6
8. Haplopappus nuttallii	4,6	0.34	18.57	71	34	0.7	2.2
9. Cryptantha sericea	7,2	0.31	32.86	100	31	1.3	1.5
10. Sphaeralcea coccinea	6,2	0.24	5.71	43	24	1.3	3.8
11. Eriogonum lonchophyllum	2,4	0.23	14.29	29	23	0.6	10.5
12. Euphorbia fendleri	3,2	0.21	17.14	43	21	0.5	3.2
13. Sitanion longifolium	6	0.10	7.14	43	10	*	**
14. Agropyron inerme	2	0.09	8.57	14	9	0.5	3.0
15. Erigeron eatonii	2	0.07	11.43	57	7	*	**
16. Carex ceyeri	2	0.07	4.29	29	7	*	**
17. Hymenopappus filifolius	2	0.06	2.86	14	6	0.0	1.0
18. Eriogonum umbellatum	2	0.06	2.86	14	6	0.1	2.0
19. Astragalus diversifolius	2,6	0.04	4.29	43	4	0.1	1.3
20. Penstemon caespitosus	2	0.04	4.29	29	4	0.1	1.3
21. Trifolium gymnocarpon	2	0.03	11.43	29	3	0.2	2.1
22. Gutierrezia sarothrae	2	0.03	2.86	29	3	0.0	1.0
23. Streptanthus cordatus	6	0.03	1.43	14	3	0.0	1.0
24. Balsamorhiza sagittata	2	0.03	1.43	14	3	0.0	1.0
25. Castilleja linariaefolia	4	0.03	1.43	14	3	0.0	1.0
26. Arenaria eastwoodiae	5	0.01	5.71	29	1	0.1	2.5
27. Ipomopsis congesta	4	0.01	4.29	14	1	0.1	1.3
28. Agoseris glauca	2	0.01	4.29	14	1	0.1	1.3
29. Chenopodium fremontii	3	0.01	2.86	29	1	0.1	2.5
30. Astragalus spatulatus	2	0.01	1.43	14	1	0.1	7.0
31. Crepis acuminata	2	0.01	1.43	14	1	0.0	2.0
32. Senecio multilobatus	2	0.01	1.43	14	1	0.1	5.0
33. Physaria floribunda	2	0.00	8.57	43	0	0.1	1.5
34. Astragalus chamaeleuce	2	0.00	4.29	29	0	0.1	1.3
35. Phlox longifolia	2	0.00	2.86	14	0	0.1	3.5

Table 3-7-20 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 7 TRANSECTS) CONTINUED							
36. Antennaria microphylla	2	0.00	1.43	14	0	0.0	1.0
37. Astragalus purshii	2	0.00	1.43	14	0	0.0	2.0
38. Chaenactis douglasii	2	0.00	1.43	14	0	0.0	1.0
39. Lygodesmia jucea	2	0.00	1.43	14	0	*	**
All Species		5.88			588		
SEPTEMBER 1975 (SUMMARY OF 7 TRANSECTS)							
1. Agropyron trachycaulum	2	0.94	52.86	100	94	*	**
2. Poa sandbergii	2	0.70	31.43	71	70	*	**
3. Oryzopsis hymenoides	2,7	0.36	34.24	100	36	*	**
4. Moss	*	0.34	7.14	43	34	*	**
5. Haplopappus nuttallii	7,2	0.31	20.00	71	31	0.3	1.5
6. Phlox hoodii	2	0.27	27.14	71	27	0.7	2.5
7. Euphorbia fendleri	2	0.21	15.71	43	21	0.4	2.5
8. Eriogonum lanchophyllum	2,6	0.20	12.86	29	20	0.4	3.0
9. Cryptantha sericea	1,2	0.17	30.00	86	17	0.8	2.6
10. Koeleria gracilis	2	0.16	12.86	29	16	*	**
11. Sphaeralcea coccinea	2	0.11	5.71	43	11	0.6	10.5
12. Stipa comata	2	0.10	10.00	14	10	*	**
13. Stanion longifolium	8	0.10	4.29	14	10	*	**
14. Carex geyeri	2	0.06	4.24	29	6	*	**
15. Eriogonum umbellatum	2	0.06	2.86	14	6	0.1	2.0
16. Penstemon caespitosus	2	0.04	4.29	29	4	0.1	1.3
17. Hymenopappus filifolius	2	0.04	4.29	14	4	0.0	1.0
18. Agropyron smithii	2	0.03	4.29	29	3	*	**
19. Phycaria floribunda	2	0.03	4.29	14	3	0.1	1.7
20. Astragalus diversifolius	2	0.03	2.86	29	3	0.1	3.0
21. Bromus tectorum	8	0.03	1.43	14	3	*	**
22. Erigeron eatonii	2	0.01	7.14	43	1	0.1	1.2
23. Ipomopsis congesta	6	0.01	4.29	14	1	0.1	1.7
24. Arenaria eastwoodiae	7	0.01	2.86	29	1	0.1	2.5
25. Chenopodium fremontii	8	0.01	1.43	14	1	0.5	5.0

Table 3-7-20 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
SEPTEMBER 1975 (SUMMARY OF 7 TRANSECTS) CONTINUED							
26. Senecio multilobatus	2	0.01	1.43	14	1	0.0	2.0
27. Aster campestris	5	0.01	1.43	14	1	0.0	1.0
28. Balsamorhiza sagittata	8	0.01	1.43	14	1	0.0	1.0
29. Astragalus spatulatus	2	0.00	4.29	14	0	0.1	1.3
30. Polyganum sawatchense	2	0.00	1.43	14	0	0.0	3.0
31. Astragalus chamaeleuce	2	0.00	1.43	14	0	0.0	1.0
32. Streptanthus cordatus	2	0.00	1.43	14	0	0.0	1.0
All Species		4.36			436		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-21 Species encountered in the mature tree stratum of the pinyon-juniper mixed brush, pinyon-juniper sagebrush, and pinyon-juniper woodland associations for RBOSP

Species	Percent Cover	Percent Frequency	Density #/ha	Constancy	Basal Area/Ha
PINYON-JUNIPER MIXED BRUSH					
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 8 TRANSECTS)					
1. Pinus edulis	10.56	65.00	114.58	100	17.47
2. Juniperus osteosperma	4.29	47.50	58.33	63	5.83
All Species	14.85		172.91		23.30
PINYON-JUNIPER SAGEBRUSH					
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 8 TRANSECTS)					
1. Juniperus osteosperma	11.45	80.00	181.25	100	21.44
2. Pinus edulis	9.32	50.00	118.75	75	3.83
All Species	20.77		300.00		25.27
PINYON-JUNIPER WOODLAND					
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 9 TRANSECTS)					
1. Pinus edulis	14.28	62.22	100.00	100	39.00
2. Juniperus osteosperma	13.05	91.11	183.33	89	21.03
All Species	27.33		283.33		60.03

Table 3-7-22 Species encountered in the shrub stratum of the pinyon-juniper mixed brush, pinyon-juniper sagebrush, and pinyon-juniper woodland associations for RBOSP

Species	Percent Cover	Percent Frequency	Density #/ha
	PINYON-JUNIPER MIXED BRUSH		
	MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 8 TRANSECTS)		
1. *Amelanchier utahensis*	7.75	92.50	1175
2. *Artemisia tridentata*	6.87	97.50	2323
3. *Pinus edulis*	2.01	90.00	427
4. *Purshia tridentata*	1.11	52.50	271
5. *Cercocarpus montanus*	0.91	30.00	263
6. *Symphoricarpos oreophilus*	0.62	50.00	435
7. *Chrysothamnus viscidiflorus*	0.40	57.50	446
8. *Juniperus osteosperma*	0.33	62.50	165
9. *Tetradymia canescens*	0.08	17.50	108
10. *Opuntia polyacantha*	0.07	10.00	110
11. *Ceanothus martini*	0.03	5.00	4
12. *Gutierrezia sarothrae*	0.01	25.00	185
13. *Chrysothamnus nauseosus*	0.00	12.50	15
14. *Opuntia fragilis*	0.00	10.00	38
15. *Atriplex confertifolia*	0.00	2.50	2
All Species	20.19		5867
	PINYON-JUNIPER SAGEBRUSH		
	MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 8 TRANSECTS)		
1. *Artemisia tridentata*	7.42	100.00	2542
2. *Purshia tridentata*	0.83	20.00	623
3. *Chrysothamnus viscidiflorus*	0.53	45.00	354
4. *Juniperus osteosperma*	0.23	50.00	85
5. *Gutierrezia sarothrae*	0.11	15.00	273
6. *Chrysothamnus nauseosus*	0.04	25.00	206
7. *Pinus edulis*	0.08	60.00	252
8. *Amelanchier utahensis*	0.07	20.00	179
9. *Symphoricarpos oreophilus*	0.04	10.00	25
10. *Opuntia polyacantha*	0.02	25.00	63
11. *Tetradymia canescens*	0.02	15.00	56
12. *Opuntia fragilis*	0.01	12.50	40
13. *Eurotia lanata*	0.00	7.50	67
14. *Cercocarpus montanus*	0.00	5.00	23
All Species	9.45		4788

Table 3-7-22 (Continued)

Species	Percent Cover	Percent Frequency	Density #/ha
PINYON-JUNIPER WOODLAND			
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 9 TRANSECTS)			
1. *Purshia tridentata*	0.87	53.33	326
2. *Cercocarpus montanus*	0.72	40.00	181
3. *Pinus edulis*	0.64	60.00	176
4. *Artemisia tridentata*	0.31	60.00	270
5. *Chrysothamnus viscidiflorus*	0.25	24.44	161
6. *Atriplex confertifolia*	0.16	17.78	83
7. *Juniperus osteosperma*	0.08	17.78	28
8. *Opuntia polyacantha*	0.05	22.22	50
9. *Tetradymia canescens*	0.01	6.67	17
10. *Chrysothamnus nauseosus*	0.00	13.33	31
11. *Amelanchier utahensis*	0.00	11.11	46
12. *Artemisia frigida*	0.00	8.84	30
13. *Symphoricarpos oreophilus*	0.00	8.89	11
14. *Ephedra viridis*	0.00	4.44	13
15. *Gutierrezia sarothrae*	0.00	2.22	4
All Species	3.09		1427

*Value not recorded in the field because of sampling procedure or absence of species.

Table 3-7-23 Species encountered in the herbaceous stratum of the pinyon-juniper mixed brush, pinyon-juniper sagebrush, and pinyon-juniper woodland associations for RBOSP

Species	Percent Cover	Percent Frequency	Density #/quad.
PINYON-JUNIPER MIXED BRUSH			
JULY 1975 (SUMMARY OF 2 TRANSECTS)			
1. *Agropyron trachycaulum*	1.30	30.00	*
2. *Eriogonum lonchophyllum*	0.55	30.00	2.4
3. *Haplopappus nuttallii*	0.50	25.00	0.8
4. *Euphorbia fendleri*	0.35	25.00	1.7
5. *Agropyron inerme*	0.30	30.00	*
6. *Phlox hoodii*	0.20	35.00	1.2
7. *Oryzopsis hymenoides*	0.20	20.00	*
8. *Cryptantha sericea*	0.15	30.00	0.7
9. *Penstemon caespitosus*	0.10	10.00	0.3
10. *Astragalus diversifolius*	0.10	5.00	5.2
	3.75		12.3
Total Number of Herbaceous Species 21			
Total Cover of Herbaceous Species	4.05		
PINYON-JUNIPER SAGEBRUSH			
JULY 1975 (SUMMARY OF 3 TRANSECTS)			
1. *Agropyron trachycaulum*	1.27	53.33	*
2. *Koeleria gracilis*	0.97	30.00	*
3. *Stipa comata*	0.90	26.67	*
4. *Agropyron smithii*	0.87	23.33	*
5. *Poa sandbergii*	0.87	16.67	*
6. *Oryzopsis hymenoides*	0.70	33.33	*
7. *Sphaeralcea coccinea*	0.53	13.33	2.2
8. *Phlox hoodii*	0.47	30.00	1.6
9. *Cryptantha sericea*	0.40	46.67	2.9
10. *Haplopappus nuttallii*	0.30	20.00	0.7
	7.28		
Total Number of Herbaceous Species 26			
Total Cover of Herbaceous Species	8.31		

Table 3-7-23 (Continued)

Species	Percent Cover	Percent Frequency	Density #/quad
PINYON-JUNIPER WOODLAND			
JULY 1975 (SUMMARY OF 2 TRANSECTS)			
1. *Poa sandbergii*	1.20	15.00	*
2. *Oryzopsis hymenoides*	0.60	30.00	*
3. *Agropyron trachycaulum*	0.35	55.00	*
4. *Cryptantha sericea*	0.35	30.00	3.8
5. *Phlox hoodii*	0.30	20.00	0.9
6. *Haplopappus nuttallii*	0.25	10.00	0.2
7. *Sitanion longifolium*	0.20	15.00	*
8. *Eriogonum umbellatum*	0.20	10.00	0.4
9. *Euphorbia fendleri*	0.15	5.00	0.8
10. *Erigeron eatonii*	0.10	10.00	0.1
	3.70		6.2
Total Number of Herbaceous Species 24			
Total Cover of Herbaceous Species	4.25		

*Value not recorded in the field because of sampling procedure or absence of species.

Table 3-7-24 Species encountered in the mature tree stratum in the sagebrush type for RBOSP

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 25 TRANSECTS)						
1. Juniperus osteosperma	0.00	1.60	8	0	1.33	0.23
2. Pinus edulis	0.00	0.80	4	0	0.67	0.04
All Species	0.00			0	2.00	0.27

Table 3-7-25 Species encountered in the shrub-tree seedling stratum in the sagebrush type for RBOSP.

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 23 TRANSECTS)										
1. *Artemisia tridentata*	*	*	*	24.11	100.00	100	2411	10595	*	**
2. *Chrysothamnus viscidiflorus*	*	*	*	1.19	23.91	30	119	510	*	**
3. *Amelanchier utahensis*	*	*	*	1.14	32.61	39	114	316	*	**
4. *Chrysothamnus* sp.	*	*	*	0.84	36.96	43	84	786	*	**
5. *Atriplex confertifolia*	*	*	*	0.58	13.04	17	58	244	*	**
6. *Sarcobatus vermiculatus*	*	*	*	0.51	18.48	22	51	198	*	**
7. *Chrysothamnus nauseosus*	*	*	*	0.32	16.30	22	32	152	*	**
8. *Symphoricarpos oreophilus*	*	*	*	0.20	22.83	35	20	226	*	**
9. *Pinus edulis*	*	*	*	0.13	22.83	43	13	46	*	**
10. *Eurotia lanata*	*	*	*	0.13	17.39	22	13	202	*	**
11. *Purshia tridentata*	*	*	*	0.09	11.96	22	9	31	*	**
12. *Juniperus osteosperma*	*	*	*	0.07	18.48	39	7	36	*	**
13. *Tetradymia canescens*	*	*	*	0.02	6.52	13	2	83	*	**
14. *Atriplex canescens*	*	*	*	0.01	8.70	9	1	29	*	**
All Species				29.34			2934	13454		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 25 TRANSECTS)										
1. *Artemisia tridentata*	2	3	4,5,6	25.01	98.40	100	2501	8249	.20	1757
2. *Symphoricarpos oreophilus*	1,2	2,4	2,7	2.79	48.00	60	279	985	1.09	674
3. *Amelanchier utahensis*	1,2	5	2,6,7	2.43	40.80	52	243	439	2.17	671
4. *Chrysothamnus viscidiflorus*	2,8	2,3	2,4,5,6	1.96	80.80	92	196	3174	.01	13
5. *Chrysothamnus nauseosus*	2	3	2,4,5,6	1.06	20.80	32	106	412	.73	208
6. *Sarcobatus vermiculatus*	2	*	6	.32	7.20	12	32	99	.14	26
7. *Gutierrezia sarothrae*	*	*	4,5,6	.22	13.60	16	22	100	*	**
8. *Purshia tridentata*	2	5	7	.18	8.80	16	18	34	.00	0
9. *Tetradymia canescens*	2	2	2	.09	17.60	28	9	140	.00	0
10. *Cercocarpus montanus*	*	*	2	.08	.80	4	8	10	*	**
11. *Pinus edulis*	2	2	2	.06	15.20	24	6	17	.00	0

Table 3-7-25 (Continued)

	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 25 TRANSECTS) (CONTINUED)										
12. Eurotia lanata	2	2	2	.06	15.20	24	6	17	.00	0
13. Opuntia polyacantha	2	*	2	.04	18.40	32	4	95	.01	1
14. Atriplex confertifolia	2	*	*	.03	4.00	4	3	32	.00	0
15. Atriplex canescens	2	*	*	.01	1.60	8	1	3	.00	0
16. Rosa woodsii	8	*	*	.00	.80	4	0	1	*	**
17. Ribes cereum	*	5	2	.00	2.40	8	0	6	*	**
All Species				34.25			3425	13925		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-26 Species encountered in the herbaceous stratum in the sagebrush type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 23 TRANSECTS)							
1. Poa sp.	*	1.66	25.65	52	166	*	**
2. Agropyron smithii	*	1.02	26.09	43	102	*	**
3. Bromus tectorum	*	0.70	6.96	22	70	*	**
4. Arenaria sp.	*	0.60	13.91	30	60	*	**
5. Agropyron trachycaulum	*	0.57	22.17	39	57	*	**
6. Koeleria gracilis	*	0.55	13.04	26	55	*	**
7. Stipa comata	*	0.54	6.09	17	54	*	**
8. Oryzopsis hymenoides	*	0.42	11.30	39	42	*	**
9. Lupinus sp.	*	0.36	9.57	30	36	*	**
10. Phlox hoodii	*	0.29	8.26	13	29	*	**
11. Penstemon caespitosus	*	0.27	7.83	30	27	*	**
12. Carex sp.	*	0.26	7.83	17	26	*	**
13. Moss	*	0.24	1.74	4	24	*	**
14. Poa sandbergii	*	0.22	3.48	4	22	*	**
15. Erigeron sp.	*	0.21	11.74	39	21	*	**
16. Hedysarum boreale	*	0.20	3.48	17	20	*	**
17. Gutierrezia sarothrae	*	0.15	6.52	30	15	*	**
18. Sitanion longifolium	*	0.14	4.78	22	14	*	**
19. Haplopappus nuttallii	*	0.13	6.09	22	13	*	**
20. Oxytropis lambertii	*	0.11	2.17	9	11	*	**
21. Eriogonum sp.	*	0.09	3.48	13	9	*	**
22. Stipa sp.	*	0.09	1.74	9	9	*	**
23. Cryptantha sericea	*	0.07	3.04	26	7	*	**
24. Lepidium sp.	*	0.07	2.17	4	7	*	**
25. Astragalus sp.	*	0.06	3.48	22	6	*	**
26. Penstemon sp.	*	0.06	2.17	9	6	*	**
27. Physaria floribunda	*	0.05	3.91	22	5	*	**
28. Balsamorhiza sagittata	*	0.05	0.43	4	5	*	**
29. Aster sp.	*	0.03	2.61	13	3	*	**
30. Ipomopsis sp.	*	0.03	2.17	22	3	*	**
31. Elymus cinereus	*	0.03	1.30	4	3	*	**
32. Penstemon strictus	*	0.03	1.30	9	3		

Table 3-7-26 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 23 TRANSECTS) CONTINUED							
33. Agropyron spicatum	*	0.03	0.43	4	3	*	**
34. Sphaeralcea coccinea	*	0.02	3.04	17	2	*	**
35. Chenopodium sp.	*	0.02	0.87	4	2	*	**
36. Bouteloua gracilis	*	0.01	0.87	4	1	*	**
37. Elymus sp.	*	0.01	0.43	4	1	*	**
38. Eriogonum ovalifolium	*	0.01	0.43	4	1	*	**
39. Descurainia sp.	*	0.00	0.43	4	0	*	**
40. Lithospermum sp.	*	0.00	0.43	4	0	*	**
41. Senecio sp.	*	0.00	0.43	4	0	*	**
42. Townsendia incana	*	0.00	0.43	4	0	*	**
43. Trifolium gymnocarpon	*	0.00	0.43	4	0	*	**
44. Unknown Gramineae	*	1.96	17.17	**	196	*	**
45. Unknown Crucifereae	*	0.01	1.74	**	1	*	**
All Species		11.37			1137		
MAY-JUNE 1975 (SUMMARY OF 7 TRANSECTS)							
1. Poa sp.	2,3	1.31	32.86	86	131	*	**
2. Phlox hoodii	2,3,4	1.06	5.71	14	106	*	**
3. Carex geyeri	2	0.90	10.00	14	90	*	**
4. Lupinus sp.	2,1	0.51	15.71	43	51	*	**
5. Agropyron smithii	2	0.44	14.29	43	44	*	**
6. Oryzopsis hymenoides	2	0.27	20.00	43	27	*	**
7. Agropyron sp.	2	0.26	35.71	71	26	*	**
8. Elymus cinereus	2	0.26	8.57	14	26	*	**
9. Phlox multiflora	4,2,3	0.24	11.43	28	24	*	**
10. Penstemon sp.	2	0.23	15.71	28	23	*	**
11. Trifolium gymnocarpon	2,3	0.14	17.14	28	14	*	**
12. Koeleria gracilis	2	0.11	12.86	43	11	*	**
13. Descurainia richardsonii	2	0.11	11.48	14	11	*	**
14. Cryptantha sericea	2,3	0.11	7.14	28	11	*	**
15. Eriogonum umbellatum	2	0.11	5.71	14	11	*	**
16. Carex sp.	2	0.11	4.29	14	11	*	**
17. Erigeron sp.	3,2	0.09	17.14	28	9	*	**
18. Senecio multilobatus	2	0.09	5.71	14	9	*	**
19. Hedysarum boreale	2,3	0.09	2.86	28	9	*	**
20. Stipa sp.	2	0.08	8.57	43	8	*	**

Table 3-7-26 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
MAY-JUNE 1975 (SUMMARY OF 7 TRANSECTS) CONTINUED							
21. Hordeum jubatum	2	0.07	1.43	14	7	*	**
22. Poa sandbergii	2	0.05	4.29	14	5	*	**
23. Solidago sp.	2	0.04	11.43	28	4	*	**
24. Lomatium sp.	2,3	0.03	12.86	28	3	*	**
25. Bromus sp.	1	0.03	2.86	14	3	*	**
26. Viola nuttallii	5	0.03	2.86	14	3	*	**
27. Phlox longifolia	3,4,2	0.02	8.57	28	2	*	**
28. Lepidium montanum	2	0.02	2.86	14	2	*	**
29. Senecio sp.	2	0.02	2.86	28	2	*	**
30. Haplopappus nuttallii	2	0.02	1.43	14	2	*	**
31. Castilleja chromosa	3	0.01	10.00	28	1	*	**
32. Crepis acuminata	2	0.01	7.14	14	1	*	**
33. Sitanion longifolium	*	0.01	7.14	28	1	*	**
34. Taraxacum officinale	2	0.01	4.28	28	1	*	**
35. Eriogonum ovalifolium	2,3	0.01	1.43	14	1	*	**
36. Euphorbia robusta	2	0.01	1.43	14	1	*	**
37. Haplopappus acaulis	2	0.01	1.43	14	1	*	**
38. Poa cusickii	3	0.01	1.43	14	1	*	**
39. Sisymbrium sp.	2,4	0.00	14.29	57	0	*	**
40. Chenopodium fremonti	2	0.00	7.14	14	0	*	**
41. Sphaeralcea coccinea	2	0.00	5.72	43	0	*	**
42. Agoseris glauca	2	0.00	4.29	28	0	*	**
43. Phlox sp.	2	0.00	4.29	14	0	*	**
44. Astragalus sp.	3,4,2	0.00	2.86	28	0	*	**
45. Bromus tectorum	2	0.00	2.86	28	0	*	**
46. Calochortus sp.	2	0.00	2.86	14	0	*	**
47. Delphinium nelsonii	2	0.00	4.29	28	0	*	**
48. Festuca sp.	2	0.00	2.86	14	0	*	**
49. Oenothera sp.	2	0.00	2.86	14	0	*	**
50. Zygadenus venenosus	2	0.00	2.86	14	0	*	**
51. Androsace septentrionalis	3	0.00	1.43	14	0	*	**
52. Claytonia sp.	3	0.00	1.43	14	0	*	**
53. Cymopterus sp.	3	0.00	1.43	14	0	*	**
54. Geranium sp.	2	0.00	1.43	14	0	*	**
55. Ipomopsis sp.	2	0.00	1.43	14	0	*	**
56. Kochia iranica	2	0.00	1.43	14	0	*	**
57. Lepidium sp.	2	0.00	1.43	14	0	*	**

Table 3-7-26 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
MAY-JUNE 1975 (SUMMARY OF 7 TRANSECTS) CONTINUED							
58. Mertensia sp.	3	0.00	1.43	14	0	*	**
59. Physaria sp.	2	0.00	*	*	0	*	**
60. Physaria floribunda	2	0.00	2.86	28	0	*	**
61. Plantago sp.	2	0.00	1.43	14	0	*	**
62. Sisymbrium altissimum	2	0.00	1.43	14	0	*	**
Unknown	*	0.16	12.86	**	16	*	**
All Species		7.09			709		
JULY 1975 (SUMMARY OF 7 TRANSECTS)							
1. Lupinus caudatus	5,3,6,7	2.47	30.00	43	247	0.8	2.8
2. Poa sandbergii	2	1.96	30.00	43	196	*	**
3. Carex geyeri	2	1.67	12.86	14	167	*	**
4. Agropyron smithii	5,2	1.24	38.57	86	124	0.0	0.1
5. Phlox multiflora	6	0.77	5.71	14	77	0.3	5.5
6. Galium boreale	2	0.70	12.86	14	70	2.9	22.4
7. Elymus cinereus	2	0.70	7.14	14	70	*	**
8. Stipa columbiana	5	0.59	12.86	14	59	*	**
9. Penstemon caespitosus	5	0.51	14.29	14	51	0.7	4.7
10. Trifolium gymnocarpon	2,6	0.44	22.86	29	44	1.2	5.2
11. Poa fendleriana	5	0.44	12.86	43	44	*	**
12. Oryzopsis hymenoides	5,2,3,4	0.41	15.71	43	41	*	**
13. Eriogonum umbellatum	4	0.40	10.00	14	40	0.6	5.6
14. Sitanion longifolium	5,6,7	0.36	17.14	43	36	*	**
15. Hedysarum boreale	4,5	0.36	1.43	14	36	0.0	2.0
16. Phlox hoodii	2	0.31	11.43	28	31	0.3	2.9
17. Stipa comata	6,5	0.30	11.43	43	30	*	**
18. Geranium richardsonii	3	0.30	8.57	14	30	0.2	2.0
19. Erigeron eatonii	7,6	0.27	22.86	43	27	0.8	3.6
20. Phlox longifolia	6,4,2,3,7	0.26	30.00	57	26	1.4	4.7
21. Lepidium perfoliatum	2	0.24	12.86	14	24	0.9	7.2
22. Sphaeralcea coccinea	2,4	0.21	15.71	43	21	0.7	4.2
23. Erigeron speciosus	2	0.20	4.29	14	20	0.8	18.7
24. Comandra umbellata	4	0.20	4.29	14	20	0.4	8.3
25. Cryptantha sericea	2,6,3	0.17	14.29	57	17	0.5	3.8

Table 3-7-26 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
		JULY 1975 (SUMMARY OF 7 TRANSECTS)					
26. Crepis acuminata	2,3,4,6	0.17	12.86	29	17	0.3	2.0
27. Penstemon fremontii	3	0.16	7.14	29	16	0.1	1.8
28. Chenopodium fremontii	2,3	0.11	15.71	57	11	0.8	5.1
29. Astragalus tenellus	4	0.11	5.71	14	11	0.1	2.2
30. Castilleja chromosa	4,5	0.09	7.14	29	9	0.1	1.2
31. Poa pratensis	2	0.09	2.86	14	9	*	**
32. Achillea lanulosa	2	0.07	4.29	14	7	0.2	4.3
33. Bromus tectorum	5,4	0.07	2.86	29	7	*	**
34. Agoseris glauca	6	0.06	10.00	29	6	0.2	2.3
35. Erogeron pumilus	5,6	0.06	4.29	29	6	0.1	1.3
36. Helianthella uniflora	2	0.06	2.86	14	6	0.1	4.5
37. Koeleria gracilis	2	0.04	4.29	29	4	*	**
38. Agropyron sp.	4	0.04	1.43	14	4	*	**
39. Agropyron trachycaulum	2,4,5	0.03	11.43	43	3	*	**
40. Osmorhiza depauperata	2	0.03	1.43	14	3	0.0	2.0
41. Chenopodium leptophyllum	3	0.01	12.86	29	1	0.3	2.6
42. Erysimum asperum	7,5	0.01	7.14	43	1	0.1	1.4
43. Descurainia pinnata	5,2	0.01	5.71	29	1	0.2	3.7
44. Taraxacum officinale	2	0.01	5.71	29	1	0.1	2.0
45. Astragalus chamaeleuce	2	0.01	4.29	14	1	0.1	1.3
46. Ipomopsis aggregata	2	0.01	4.29	29	1	0.1	1.7
47. Physaria floribunda	2,5	0.01	4.29	43	1	0.1	1.7
48. Ipomopsis congesta	4	0.01	2.86	14	1	0.0	1.0
49. Zygadenus venenosus	2,6	0.01	2.86	14	1	0.0	1.0
50. Calochortus nuttallii	3	0.01	1.43	14	1	0.0	1.0
51. Haplopappus nuttallii	4	0.01	1.43	14	1	0.0	1.0
52. Kochia iranica	2	0.01	1.43	14	1	0.0	1.0
53. Lappula redowskii	4,7	0.00	5.71	29	0	0.1	1.0
54. Astragalus diversifolius	2	0.00	2.86	14	0	0.0	1.0
55. Astragalus purshii	2	0.00	1.43	14	0	0.0	1.0
56. Collomia linearis	2	0.00	1.43	14	0	0.0	1.0
57. Eriogonum ovalifolium	4	0.00	1.43	14	0	0.0	1.0
58. Euphorbia fendleri	3	0.00	1.43	14	0	0.0	**
59. Polygonum sawatchense	3	0.00	1.43	14	0	0.0	1.0
60. Senecio multilobatus	2	0.00	1.43	14	0	0.0	1.0
All Species		16.79			1679		

Table 3-7-26 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
SEPTEMBER 1975 (SUMMARY OF 6 TRANSECTS)							
1. *Carex geyeri*	2	2.93	15.00	17	293	*	**
2. *Poa sandbergii*	2	1.45	40.00	50	145	*	**
3. *Stipa columbiana*	7	1.10	15.00	17	110	*	**
4. *Phlox multiflora*	8	1.03	6.67	17	103	0.6	8.3
5. *Galium boreale*	2	0.80	15.00	17	80	2.6	17.3
6. *Koeleria gracilis*	2,7	0.72	26.67	50	72	*	**
7. *Lupinus caudatus*	2,8	0.72	25.00	50	72	0.5	2.0
8. *Penstemon caespitosus*	2,8	0.65	23.33	33	65	0.9	3.8
9. *Poa canbyi*	2	0.47	10.00	17	47	*	**
10. *Oryzopsis hymenoides*	2,7	0.38	23.33	67	38	*	**
11. Moss	2	0.35	18.33	67	35	*	**
12. *Eriogonum umbellatum*	2	0.35	10.00	33	35	0.6	5.8
13. *Hedysarum boreale*	2	0.33	1.67	17	33	0.1	6.0
14. *Agropyron smithii*	2,7	0.27	21.67	50	27	*	**
15. *Comandra umbellata*	2	0.27	5.00	17	27	0.4	8.0
16. *Erigeron eatonii*	2,8	0.23	20 00	33	23	1.0	4.9
17. *Lepidium montanum*	6	0.22	10.00	17	22	1.1	10.5
18. *Stipa comata*	2	0.20	13 33	33	20	*	**
19. *Phlox hoodii*	2	0.18	13.33	33	18	0.4	3.1
20. *Erigeron speciosus*	6	0.17	8.33	17	17	0.6	7.6
21. *Geranium richardsonii*	7	0.15	5.00	17	15	0.1	1.7
22. *Helianthella uniflora*	7	0.13	3.33	17	13	0.2	6.5
23. *Sphaerulrea coccinea*	2	0.10	18.33	50	10	0.7	4.0
24. *Chenopodium leptophyllum*	2,6,7	0.10	16.67	50	10	0.6	3.5
25. *Cryptantha sericea*	2	0.10	11.67	33	10	0.6	5.3
26. *Sitanion longifolium*	8	0.07	11.67	50	7	*	**
27. *Agropyron trachycalum*	2,7	0.07	10.00	50	7	*	**
28. *Agropyron spicatum*	6	0.07	1.67	17	7	*	**
29. *Ligusticum porteri*	2	0.07	1.67	17	7	0.1	3.0
30. *Ipomopsis aggregata*	2	0.05	3.33	17	5	0.1	1.5
31. *Astragalus tenellus*	2	0.05	3.33	17	5	0.1	1.5
32. *Bromus tectorum*	8	0.03	5.00	17	3	*	**
33. *Achillea lanulosa*	2	0.03	3.33	17	3	0.2	6.0
34. *Ipomopsis congesta*	5	0.02	3.33	17	2	0.1	1.5
35. *Physaria floribunda*	2	0.02	3.33	33	2	0.1	1.5

Table 3-7-26 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
SEPTEMBER 1975 (SUMMARY OF 6 TRANSECTS) CONTINUED							
36. Antennaria pulcherrima	2	0.02	3.33	17	2	0.0	1.0
37. Phlox longifolia	7	0.02	1.67	17	2	0.1	5.0
38. Haplopappus nuttallii	2	0.02	1.67	17	2	0.0	2.0
39. Euphorbia fendleri	2	0.02	1.67	17	2	0.0	1.0
40. Kochia iranica	6	0.02	1.67	17	2	0.0	1.0
41. Astragalus chamaeleuce	2	0.00	3.33	17	0	0.0	1.0
42. Sisymbrium linifolium	1	0.0.00	1.67	17	0	0.0	2.0
43. Castilleja linariaefolia	2	0.00	1.67	17	0	0.0	1.0
All Species		13.98			1398		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-27 Species encountered in the shrub stratum of the upland sagebrush and bottomland sagebrush associations for RBOSP

Species	Percent Cover	Percent Frequency	Density #/ha
UPLAND SAGEBRUSH			
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 16 TRANSECTS)			
1. *Artemisia tridentata*	21.56	97.50	5581
2. *Amelanchier utahensis*	3.55	52.50	621
3. *Symphoricarpos oreophilus*	1.77	48.75	621
4. *Chrysothamnus viscidiflorus*	1.53	93.75	1954
5. *Gutierrezia sarothrae*	0.34	21.25	156
6. *Purshia tridentata*	0.28	13.75	53
7. *Tetradymia canescens*	0.13	21.25	178
8. *Cercocarpus montanus*	0.13	1.25	16
9. *Pinus edulis*	0.10	21.25	26
10. *Juniperus osteosperma*	0.06	15.00	28
11. *Opuntia polyacantha*	0.05	20.00	64
12. *Eurotia lanata*	0.09	8.75	33
13. Unknown shrub	0.02	1.25	3
14. *Chrysothamnus nauseosus*	0.00	2.50	9
15. *Rosa woodsii*	0.00	1.25	2
All Species	29.56		9345
BOTTOMLAND SAGEBRUSH			
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 9 TRANSECTS)			
1. *Artemisia tridentata*	31.14	100.00	10578
2. *Symphoricarpos oreophilus*	4.59	46.67	1167
3. *Chrysothamnus nauseosus*	2.94	42.22	1128
4. *Chrysothamnus viscidiflorus*	2.70	57.78	5198
5. *Sarcobatus vermiculatus*	0.90	20.00	276
6. *Amelanchier utahensis*	0.44	20.00	115
7. *Atriplex confertifolia*	0.08	11.11	89
8. *Opuntia polyacantha*	0.04	15.56	150
9. *Eurotia lanata*	0.03	8.89	85
10. *Tetradymia canescens*	0.02	11.11	70
11. *Atriplex canescens*	0.01	11.11	9
12. *Ribes cereum*	0.00	6.67	15
All Species	42.89		18,880

*Value not recorded in the field because of sampling procedure or absence of species.

Table 3-7-28 Species encountered in the herbaceous stratum in the upland sagebrush and bottomland sagebrush associations for RBOSP

Species	Percent Cover	Percent Frequency	Density #/Quad.(.5m^2)
	UPLAND SAGEBRUSH		
	JULY 1975 (SUMMARY OF 4 TRANSECTS)		
1. *Lupinus caudatus*	4.33	42.50	2.9
2. *Poa sandbergii*	3.43	50.00	*
3. *Carex geyeri*	2.93	22.50	*
4. *Phlox multiflora*	1.35	10.00	1.1
5. *Galium boreale*	1.23	22.50	10.1
6. *Stipa columbiana*	1.03	22.50	*
7. *Stipa comata*	0.98	17.50	*
8. *Agropyron smithii*	0.93	52.50	*
9. *Penstemon caespitosus*	0.90	25.00	2.4
10. *Trifolium gymnocarpon*	0.78	40.00	4.1
	17.89		20.6
Total Number of Herbaceous Species 51			
Total Cover of Herbaceous Species	26.34		
	BOTTOMLAND SAGEBRUSH		
	JULY 1975 (SUMMARY OF 3 TRANSECTS)		
1. *Agropyron smithii*	1.67	20.00	*
2. *Elymus cinereus*	1.63	16.67	*
3. *Sitanion longifolium*	0.83	40.00	*
4. *Lepidium perfoliatum*	0.57	30.00	4.3
5. *Chenopodium fremontii*	0.20	26.67	2.4
6. *Oryzopsis hymenoides*	0.13	13.33	*
7. *Chenopodium leptophyllum*	0.03	30.00	1.5
8. *Descurainia pinnata*	0.03	13.33	1.0
9. *Erysimum asperum*	0.03	10.00	3.3
10. *Bromus tectorum*	0.03	3.33	*
	5.15		12.5
Total Number of Herbaceous Species 21			
Total Cover of Herbaceous Species	5.18		

*Value not recorded in the field because of sampling procedure or absence of species.

Table 3-7-29 Species encountered in the shrub-tree seedling stratum in the greasewood type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 7 TRANSECTS)										
1. *Artemisia tridentata*	*	*	*	26.45	100.00	100	2645	10313	*	**
2. *Sarcobatus vermiculatus*	*	*	*	18.38	100.00	100	1838	4290	*	**
3. *Chrysothamnus viscidiflorus*	*	*	*	0.44	25.00	29	44	806	*	**
4. *Chrysothamnus nauseosus*	*	*	*	0.21	21.43	57	21	214	*	**
5. *Atriplex canescens*	*	*	*	0.01	21.43	14	1	44	*	**
6. *Atriplex confertifolia*	*	*	*	0.00	14.29	43	0	131	*	**
7. *Juniperus osteosperma*	*	*	*	0.00	3.57	14	0	4	*	**
All Species				45.49			4549	15802		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 6 TRANSECTS)										
1. *Sarcobatus vermiculatus*	2	2	6	29.53	100.00	100	2953	4556	0.65	550
2. *Artemisia tridentata*	2	3	5	10.41	90.00	100	1041	2981	0.16	16
3. *Chrysothamnus nauseosus*	2	3	*	3.71	46.67	50	371	1742	0.15	29
4. *Chrysothamnus viscidiflorus*	2	*	4,5	0.14	26.67	50	14	111	0.00	**
5. *Atriplex confertifolia*	2	2	*	0.07	26.67	33	7	114	0.04	0
All Species				43.86			4386	9504		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-30 Species encountered in the herbaceous stratum in the greasewood type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 7 TRANSECTS)							
1. Bromus tectorum	*	1.87	20.00	29	187	*	**
2. Lepidium perfoliatum	*	1.86	11.43	14	186	*	**
3. Agropyron trachycaulum	*	0.70	32.86	57	70	*	**
4. Kochia iranica	*	0.36	2.86	14	36	*	**
5. Agropyron smithii	*	0.07	1.43	14	7	*	**
6. Elymus cinereus	*	0.07	1.43	14	7	*	**
7. Sitanion longifolium	*	0.06	7.14	29	6	*	**
8. Physaria floribunda	*	0.01	1.43	14	1	*	**
9. Lappula redowskii	*	0.00	1.43	14	0	*	**
All Species		5.00			500		
MAY-JUNE 1975 (SUMMARY OF 3 TRANSECTS)							
1. Lappula redowskii	2,3	3.05	56.67	100	305	*	**
2. Chenopodium fremontii	2,3	2.40	76.67	100	240	*	**
3. Agropyron desertorum	2	2.35	30.00	33	235	*	**
4. Descurainia pinnata	3	1.33	80.00	100	133	*	**
5. Agropyron smithii	2	1.05	43.33	100	105	*	**
6. Bromus tectorum	2	0.88	26.67	33	88	*	**
7. Agropyron trachycaulum	2	0.30	30.00	67	30	*	**
8. Poa sandbergii	2	0.10	20.00	33	10	*	**
9. Elymus cinereus	2	0.08	6.67	33	8	*	**
10. Chenopodium leptophyllum	2	0.00	6.67	33	0	*	**
11. Lepidium perfoliatum	2	0.00	6.67	33	0	*	**
All Species		11.54			1154		

Table 3-7-30 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 3 TRANSECTS)							
1. Kochia iranica	2	9.40	36.67	67	940	35.1	95.7
2. Chenopodium album	3	6.47	63.33	67	647	20.4	32.2
3. Agropyron smithii	2	5.30	53.33	100	530	*	**
4. Chenopodium fremontii	3,2	3.47	46.67	67	347	8.3	17.8
5. Agropyron desertorum	2	2.60	30.00	33	260	*	**
6. Sitanion longifolium	7	1.20	6.67	33	120	*	**
7. Descurainia pinnata	2	0.37	20.00	33	37	1.5	7.5
8. Poa sandbergii	2	0.17	6.67	33	17	*	**
9. Agropyron trachycaulum	2	0.17	3.33	33	17	*	**
10. Elymus cinereus	5	0.13	3.33	33	13	*	**
11. Lappula redowskii	7	0.03	13.33	33	3	0.5	3.8
12. Bromus tectorum	5	0.00	3.33	33	0	*	**
13. Phlox longifolia	2	0.00	3.33	33	0	0.0	1.0
All Species		29.31			2931		
SEPTEMBER 1975 (SUMMARY OF 3 TRANSECTS)							
1. Kochia iranica	4	5.23	33.33	33	523	30.5	91.4
2. Chenopodium fremontii	5,6,7	3.97	90.00	100	397	31.7	35.2
3. Bromus tectorum	8	3.43	30.00	33	343	*	**
4. Agropyron desertorum	7	2.13	33.33	33	213	*	**
5. Agropyron smithii	2	1.80	33.33	33	180	*	**
6. Poa sandbergii	2	0.13	13.33	33	13	*	**
7. Agropyron trachycaulum	2,7	0.13	10.00	67	13	*	**
8. Elymus cinereus	2	0.10	6.67	33	10	*	**
9. Lepidium montanum	2	0.03	3.33	33	3	0.2	5.0
10. Sitanion longifolium	8	0.03	3.33	33	3	*	**
11. Lappula redowskii	8	0.00	3.33	33	0	0.2	6.0
12. Oryzopsis hymenoides	2	0.00	3.33	33	0	*	**
13. Salsola iberica	2	0.00	3.33	33	0	0.0	1.0
All Species		16.78			1678		

*Value not recorded.

**Value cannot be calculated.

Table 3-7-31 Species encountered in the shrub-tree seedling stratum in the rabbitbrush type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 5 TRANSECTS)										
1. Chrysothamnus nauseosus	*	*	*	36.14	100.00	100	3614	7400	*	**
2. Artemisia tridentata	*	*	*	3.36	40.00	40	336	1650	*	**
3. Sarcobatus vermiculatus	*	*	*	0.45	50.00	60	45	144	*	**
4. Atriplex canescens	*	*	*	0.00	5.00	20	0	6	*	**
All Species				39.95			3995	9200		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 8 TRANSECTS)										
1. Chrysothamnus viscidiflorus	2	3	2,4,5	21.27	60.00	63	2127	3637	0.02	275
2. Chrysothamnus nauseosus	2	3	4,5	14.47	77.50	88	1447	5752	0.34	3831
3. Sarcobatus vermiculatus	2	*	2,6,7	1.95	35.00	50	195	419	0.00	0
4. Artemisia tridentata	2	3	4,5,6	1.78	75.00	75	178	4025	0.00	0
5. Ribes aureum	2	*	*	0.00	2.50	13	0	1	*	**
6. Symphoricarpos oreophilus	2	*	*	0.00	2.50	13	0	1	*	**
All Species				39.47			3947	13835		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-32 Species encountered in the herbaceous stratum in the rabbitbrush type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
		OCTOBER 1974 (SUMMARY OF 5 TRANSECTS)					
1. *Elymus cinereus*	*	5.87	44.00	80	587	*	**
2. *Kochia iranica*	*	1.20	10.00	20	120	*	**
3. *Poa pratensis*	*	0.96	14.00	20	96	*	**
4. *Agropyron smithii*	*	0.74	14.00	20	74	*	**
5. *Agropyron spicatum*	*	0.48	12.00	20	48	*	**
6. *Agropyron trachycaulum*	*	0.14	4.00	20	14	*	**
7. *Lepidium perfoliatum*	*	0.11	4.00	20	11	*	**
8. *Bromus tectorum*	*	0.03	4.00	20	3	*	**
9. *Aster* sp.	*	0.03	2.00	20	3	*	**
All Species		9.56			956		
		MAY-JUNE 1975 (SUMMARY OF 2 TRANSECTS)					
1. *Elymus cinereus*	2	20.05	95.00	100	2005	*	**
2. *Bromus* sp.	2	1.40	10.00	50	140	*	**
3. *Poa* sp.	2	1.33	35.00	50	133	*	**
4. *Poa pratensis*	2,3	1.08	25.00	50	108	*	**
5. *Bromus tectorum*	3,4	0.95	35.00	50	95	*	**
6. *Sisymbrium linifolium*	3,4,5	0.38	40.00	50	38	*	**
7. *Artemisia ludoviciana*	2	0.20	15.00	50	20	*	**
8. *Scirpus acutus*	2	0.08	15.00	50	8	*	**
9. *Agropyron smithii*	2	0.05	15.00	50	5	*	**
10. *Collinsia parviflora*	3	0.00	10.00	50	0	*	**
11. *Taraxacum officinale*	2	0.00	10.00	50	0	*	**
12. *Chorispora tenella*	3,4	0.00	5.00	50	0	*	**
13. *Penstemon* sp.	2	0.00	5.00	50	0	*	**
14. Unknown Crucifereae	*	0.00	30.00	**	0	*	**
All Species		25.52			2552		

Table 3-7-32 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 2 TRANSECTS)							
1. *Elymus cinereus*	5	36.60	95.00	100	3660	*	**
2. *Poa pratensis*	5	3.90	45.00	50	390	*	**
3. *Agropyron smithii*	5	1.00	25.00	50	100	*	**
4. *Agropyron repens*	5	100	5.00	50	100	*	**
5. *Juncus balticus*	5	0.70	10.00	50	70	*	**
6. *Artemisia ludoviciana*	2	0.25	10 00	50	25	0.2	2.0
7. *Chenopodium fremontii*	2	0.15	25.00	50	15	0.6	2.4
8. *Descurainia pinnata*	7	0.00	5.00	50	0	0.2	4.0
9. *Taraxacum officinale*	2	0.00	5.00	50	0	0.1	1.0
10. Unknown	*	0.10	5.00	50	10	0.2	4.0
All Species		43.70			4370		
SEPTEMBER 1975 (SUMMARY OF 2 TRANSECTS)							
1. *Elymus cinereus*	2,6,7	17.83	80.00	100	1783	*	**
2. *Bromus tectorum*	8	3.40	36.67	67	340	*	**
3. *Poa nemoralis*	6,7	2.50	40.00	67	250	*	**
4. *Agropyron smithii*	2	1.73	30.00	67	173	*	**
5. *Agropyron trachycaulum*	7	1.00	3.33	33	100	*	**
6. *Distichlis stricta*	5	0.80	13.33	33	80	*	**
7. *Juncus arcticus*	5	0.63	10.00	33	63	*	**
8. *Sitanion longifolium*	8	0.47	6.67	33	47	*	**
9. *Chenopodium fremontii*	7,2,4	0.13	23.33	100	13	0.7	3.1
10. *Lepidium montanum*	5	0.07	6.67	33	7	0.1	2.0
11. *Artemisia ludoviciana*	6	0.07	3.33	33	7	0.1	3.0
12. *Aster campestris*	4	0.03	3.33	33	3	0.1	2.0
All Species		28.66			2866		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-33 Species encountered in the mature tree stratum in the bald type for RBOSP

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)						
1. *Juniperus osteosperma*	0.00	6.25	25	0	7	0.40
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 11 TRANSECTS)						
1. *Pinus edulis*	0.00	3.64	36	0	5	3.82

Table 3-7-34 Species encountered in the shrub-tree seedling stratum in the bald type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)										
1. Artemisia tridentata	*	*	*	1.31	25.00	25	131	403	*	**
2. Chrysothamnus viscidiflorus	*	*	*	0.00	12.50	25	0	56	*	**
3. Pinus edulis	*	*	*	0.00	12.50	25	0	21	*	**
4. Amelanchier utahensis	*	*	*	0.00	6.25	25	0	35	*	**
All Species				1.31			131	514		
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF 11 TRANSECTS)										
1. Amelanchier utahensis	2,2	2	7	3.00	12.73	45	300	41	10.89	33
2. Artemisia frigida	*	*	5,6	0.84	27.27	27	84	27	*	**
3. Gutierrezia sarothrae	*	*	5,6	0.64	16.36	18	64	16	*	**
4. Artemisia tridentata	2	3	5	0.24	29.09	64	24	55	0.01	0
5. Cercocarpus montanus	*	*	6	0.12	5.45	9	12	5	*	**
6. Tetradymia canescens	2	2	2,6	0.11	47.27	73	11	358	*	**
7. Chrysothamnus viscidiflorus	2	*	*	0.08	18.18	27	8	166	*	**
8. Pinus edulis	2	2	*	0.08	9.09	27	8	12	4.19	54
9. Symphoricarpos oreophilus	2	2	7	0.07	12.73	27	7	325	*	**
10. Chrysothamnus viscidiflorus	*	2,3	2,5,6	0.06	23.64	36	6	300	*	**
11. Purshia tridentata	2	*	*	0.05	1.82	9	5	1	0.05	0
12. Eurotia lanata	*	2	*	0.00	3.64	18	0	5	*	**
13. Juniperus osteosperma	*	2	*	0.00	1.82	9	0	2	*	**
All Species				5.29			529	1313		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-35 · Species encountered in the herbaceous stratum in the bald type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)							
1. Agropyron trachycaulum	*	5.68	85.00	100	568	*	**
2. Poa sp.	*	4.67	90.00	100	467	*	**
3. Haplopappus nuttallii	*	3.72	82.50	100	372	*	**
4. Eriogonum sp.	*	1.92	37.50	75	192	*	**
5. Penstemon caespitosus	*	1.39	50.00	75	139	*	**
6. Arenaria sp.	*	0.75	77.50	75	75	*	**
7. Hedysarum boreale	*	0.74	20.00	75	74	*	**
8. Hymemoxys acaulis	*	0.71	67.50	100	71	*	**
9. Gutierrezia sarothrae	*	0.64	40.00	100	64	*	**
10. Koeleria gracilis	*	0.57	45.00	100	57	*	**
11. Phlox sp.	*	0.44	10.00	25	44	*	**
12. Oxytropis lambertii	*	0.30	27.50	50	30	*	**
13. Astragalus sp.	*	0.09	20.00	75	9	*	**
14. Androsace septentrionalis	*	0.09	17.50	50	9	*	**
15. Penstemon sp.	*	0.08	12.50	25	8	*	**
16. Cryptantha sericea	*	0.06'	7.50	50	6	*	**
17. Eriogonum alatum	*	0.06	7.50	50	6	*	**
18. Physaria floribunda	*	0.04	12.50	50	4	*	**
19. Erigeron sp.	*	0.04	5.00	50	4	*	**
20. Oryzopsis hymenoides	*	0.03	2.50	25	3	*	**
21. Sphaeralcea coccinea	*	0.02	2.50	25	2	*	**
Unknown Cruciferceae	*	0.02	2.50	25	2	*	**
All Species		22.06			2206		

Table 3-7-35 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
MAY-JUNE 1975 (SUMMARY OF 5 TRANSECTS)							
1. *Agropyron trachycaulum*	2	1.29	92.00	100	129	*	**
2. *Koeleria gracilis*	2	1.26	64.00	80	126	*	**
3. *Haplopappus acaulis*	3	0.74	14.00	20	74	*	**
4. *Astragalus spatulatus*	2,3	0.61	34.00	20	61	*	**
5. *Penstemon caespitosus*	2	0.58	48.00	80	58	*	**
6. *Poa sandbergii*	2	0.51	34.00	40	51	*	**
7. *Haplopappus nuttallii*	2	0.47	58.00	80	47	*	**
8. *Gutierrezia sarothrae*	2	0.43	44.00	100	43	*	**
9. *Poa* sp.	2	0.36	54.00	60	36	*	**
10. *Trifolium gymnocarpon*	2,3,4	0.34	36.00	100	34	*	**
11. *Phlox multiflora*	2,4	0.26	10.00	40	26	*	**
12. *Artemisia frigida*	2	0.24	34.00	60	24	*	**
13. *Hymenoxys acaulis*	2	0.23	46.00	20	23	*	**
14. *Hedysarum boreale*	2,3	0.18	16.00	60	18	*	**
15. *Phlox longifolia*	3,2	0.12	54.00	80	12	*	**
16. *Antennaria* sp.	2	0.12	8.00	40	2	*	**
17. *Lomatium orientale*	4,3	0.08	40.00	80	8	*	**
18. *Eriogonum lonchophyllum*	2	0.08	28.00	80	8	*	**
19. *Kochia iranica*	2	0.05	12.00	20	5	*	**
20. *Stipa* sp.	2	0.05	8.00	40	5	*	**
21. *Arenaria eastwoodiae*	3	0.04	12.00	20	4	*	**
22. *Artemisia* sp.	2	0.04	8.00	20	4	*	**
23. *Arenaria fendleri*	3	0.04	4.00	20	4	*	**
24. *Physaria floribunda*	3,2	0.03	24.00	80	3	*	**
25. *Eriogonum umbellatum*	2	0.02	6.00	20	2	*	**
26. *Ipomopsis* sp.	2	0.02	4.00	20	2	*	**
27. *Carex* sp.	2	0.02	2.00	20	2	*	**
28. *Lupinus* sp.	2	0.02	2.00	20	2	*	**
29. *Townsendia incana*	2	0.02	2.00	20	2	*	**
30. *Cymopterus fendleri*	3,4	0.01	22.00	40	1	*	**

Table 3-7-35 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
31. Linum lewisii	2	0.01	2.00	20	1	*	**
32. Sitanion longifolium	2	0.00	10.00	20	0	*	**
33. Calochortus sp.	2	0.00	8.00	20	0	*	**
34. Castilleja chromosa	4	0.00	6.00	20	0	*	**
35. Erigeron sp.	2,3	0.00	6.00	60	0	*	**
36. Lomatium juniperum	3,4	0.00	6.00	20	0	*	**
37. Cryptantha sericea	2	0.00	4.00	20	0	*	**
38. Zygadenus venenosus	2,3	0.00	4.00	40	0	*	**
39. Agropyron smithii	2	0.00	2.00	20	0	*	**
40. Crepis acuminata	2	0.00	2.00	20	0	*	**
41. Delphinium nelsonii	2	0.00	2.00	20	0	*	**
42. Solidago sp.	2	0.00	2.00	20	0	*	**
43. Sphaeratcea coccinea	2	0.00	2.00	20	0	*	**
Unknown	*	0.24	34.00	*	24	*	**
All Species		8.51			851		
JULY 1975 (SUMMARY OF 5 TRANSECTS)							
1. Agropyron trachycaulum	4,2	2.14	70.00	80	214	*	**
2. Koeleria gracilis	2,4	1.96	56.00	100	196	*	**
3. Astragalus spatulatus	5,6	1.73	64.00	100	173	3.8	5.9
4. Penstemon caespitosus	2,5,4,6	1.54	74.00	100	154	2.9	3.9
5. Hymenopappus filifolius	4	1.48	20.00	20	148	1.0	4.8
6. Poa sandbergii	6,2,7	1.46	64.00	100	146	*	**
7. Hymenoxys acaulis	6,7,5,4	1.30	68.00	100	130	4.9	7.1
8. Haplopappus acaulis	6,2	1.02	20.00	40	102	0.9	4.7
9. Stipa comata	2,4,5,3	0.96	34.00	60	96	*	**
10. Agropyron smithii	2	0.90	24.00	60	90	*	**
11. Haploppapus nuttallii	4,3,2	0.84	52.00	100	84	2.4	4.6
12. Eriogonum lonchophyllum	2,5,3	0.72	36.00	100	72	0.8	2.2
13. Artemisia frigida	3,2	0.54	42.00	60	54	0.9	2.1

Table 3-7-35 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
14. Hedysarum boreale	6,5	0.50	14.00	40	50	0.4	3.0
15. Gutierrezia sarothrae	2,3	0.46	24.00	80	46	0.5	2.3
16. Trifolium gymnocarpon	2,7	0.36	28.00	80	36	0.6	2.1
17. Carex geyeri	2	0.30	4.00	20	30	*	**
18. Comandra umbellata	6,5,2	0.28	12.00	80	28	0.5	4.3
19. Phlox longifolia	6,5,7	0.26	44.00	100	26	2.1	4.8
20. Oxytropis lambertii	5,2,4	0.22	10.00	40	22	0.2	1.8
21. Astragalus chamaeleuce	5,6,2	0.21	44.00	100	21	0.7	1.6
22. Artemisia dracunculus	2	0.20	8.00	20	20	0.1	1.8
23. Eriogonum alatum	2,3,4,5	0.18	10.00	20	18	0.2	2.2
24. Sphaeralcea coccinea	6,2	0.18	4.00	40	18	0.4	9.5
25. Linum lewisii	6,3	0.16	8.00	40	16	0.3	3.5
26. Poa fendleriana	7	0.16	4.00	20	16	*	**
27. Phlox hoodii	2	0.14	10.00	20	14	0.3	3.4
28. Arenaria eastwoodiae	4	0.12	16.00	20	12	0.5	3.1
29. Ipomopsis aggregata	2	0.12	10.00	40	12	0.5	4.5
30. Leptodactylon pungens	2	0.10	4.00	20	10	0.3	6.5
31. Castilleja linariaefolia	3,4	0.08	4.00	20	8	0.1	2.5
32. Physaria floribunda	2	0.06	42.00	100	6	0.8	2.0
33. Oryzopsis hymenoides	2,5,6	0.06	10.00	40	6	*	**
34. Oenothera lavandolaefolia	5	0.06	4.00	20	6	0.1	1.5
35. Erigeron eatonii	2	0.04	6.00	20	4	0.2	2.7
36. Castilleja chromosa	7	0.04	6.00	20	4	0.1	1.7
37. Bromus tectorum	6	0.02	2.00	20	2	*	**
38. Erigeron pumilus	6	0.02	2.00	20	2	0.0	1.0
39. Zygadenus venenosus	7	0.02	2.00	20	2	0.0	1.0
40. Streptanthus cordatus	5	0.01	6.00	20	1	0.1	1.7
41. Androsace septentrionalis	5	0.00	10.00	40	0	0.1	1.4
42. Euphorbia robusta	2,4	0.00	4.00	40	0	0.1	1.5
43. Astragalus purshii	2	0.00	4.00	20	0	0.0	1.0

Table 3-7-35 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
44. Cryptantha sericea	2,3	0.00	4.00	40	0	0.0	1.0
45. Achillea lanulosa	2	0.00	2.00	20	0	0.1	3.0
46. Lupinus caudatus	2	0.00	2.00	20	0	0.0	1.0
All Species		20.95			2095		
SEPTEMBER 1975 (SUMMARY OF 2 TRANSECTS)							
1. Poa sandbergii	2	4.00	95.00	100	400	*	**
2. Haplopappus acaulis	2	3.30	85.00	100	330	4.8	5.6
3. Agropyron trachycaulum	2,7	2.50	90.00	100	250	*	**
4. Penstemon caespitosus	2	1.90	70.00	100	190	4.3	6.1
5. Haplopappus nuttallii	2	1.40	80.00	100	140	4.7	5.9
6. Astragalus spatulatus	2	1.00	70.00	100	100	3.2	4.5
7. Eriogonum lonchophyllum	6,2	0.65	40.00	100	65	1.1	2.6
8. Artemisia dracunculus	6	0.50	15.00	50	50	0.5	3.0
9. Phlox hoodii	2	0.45	15.00	50	45	1.1	7.0
10. Arenaria eastwoodiae	2	0.35	45.00	50	35	1.4	3.1
11. Hymenoxys acaulis	2	0.20	30.00	50	20	1.3	4.3
12. Ipomopsis aggregata	1,2	0.20	20.00	100	20	0.7	3.5
13. Linum lewisii	7	0.20	5.00	50	20	0.2	4.0
14. Astragalus purshii	2	0.15	55.00	100	15	0.9	1.6
15. Erigeron pumilis	2,8	0.10	10.00	100	10	0.2	1.5
16. Comandra umbellata	2	0.10	5.00	50	10	0.4	7.0
17. Lygodesmia juncea	2	0.05	10.00	50	5	0.3	3.0
18. Leptodactylon pungens	2	0.05	5.00	50	5	0.1	2.0
19. Hedysarum boreale	2	0.05	5.00	50	5	0.1	1.0
20. Oxytropis lambertii	2	0.05	5.00	50	5	0.1	1.0
21. Sphaeralcea coccinea	2	0.05	5.00	50	5	0.1	1.0
22. Physaria floribunda	1	0.00	15.00	50	0	0.3	1.7
23. Cryptantha sericea	2	0.00	5.00	50	0	0.1	1.0
All Species		17.25			1725		

Table 3-7-36 Species encountered in the mature tree stratum in the shadscale type for RBOSP

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
			OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)			
1. *Juniperus osteosperma*	.00	25.00	25	0	278	5.45
			MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF TRANSECTS)			
1. *Juniperus osteosperma*	2.66	24.00	20	266	30	2.06

Table 3-7-37. Species encountered in the shrub-tree seedling stratum in the shadscale type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 7 TRANSECTS)										
1. Chrysothamnus viscidiflorus	*	*	*	5.29	68.75	75	529	2340	*	**
2. Chrysothamnus nauseosus	*	*	*	3.67	68.75	75	367	833	*	**
3. Atriplex confertifolia	*	*	*	3.54	87.50	100	354	1931	*	**
4. Artemisia tridentata	*	*	*	1.91	62.50	100	191	917	*	**
5. Artemisia frigida	*	*	*	1.13	50.00	75	113	2229	*	**
6. Amelanchier utahensis	*	*	*	0.29	6.25	25	29	28	*	**
7. Sarcobatus vermiculatus	*	*	*	0.13	12.50	25	13	76	*	**
8. Tetradymia canescens	*	*	*	0.00	18.75	50	0	69	*	**
9. Pinus edulis	*	*	*	0.00	6.25	25	0	7	*	**
10. Rhus trilobata	*	*	*	0.00	6.25	25	0	7	*	**
All Species				15.96			1596	8437		
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS)										
1. Artemisia tridentata	2	3	5	7.49	80.00	100	749	1327	0.17	340
2. Atriplex confertifolia	2	2	2	3.92	96.00	100	392	2343	0.01	23
3. Pinus edulis	2	*	*	0.45	16.00	40	45	20	*	**
4. Tetradymia canescens	2	2	2,3	0.42	28.00	80	42	363	*	**
5. Chrysothamnus viscidiflorus	2	3	4,5	0.38	52.00	100	38	537	0.01	4
6. Sarcobatus vermiculatus	2	2	6,2	0.29	32.00	80	29	157	0.70	144
7. Atriplex canescens	2	2	*	0.25	24.00	40	25	263	0.01	4
8. Artemisia frigida	*	*	5	0.25	20.00	20	25	263	*	**
9. Chrysothamnus nauseosus	2	3	4,5	0.21	56.00	80	21	250	*	**

Table 3-7-37. (Continued)

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF 5 TRANSECTS)										
10. Eurotia lanata	*	3	*	0.05	12.00	20	5	70	*	**
11. Symphoricarpos oreophilus	*	2	*	0.00	4.00	20	0	7	*	**
12. Ephedra viridis	2	*	*	0.00	4.00	20	0	3	*	**
All Species				13.71			1371	5603		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-38. Species encountered in the herbaceous stratum in the shadscale type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)							
1. *Oryzopsis hymenoides*	*	0.87	22.50	75	87	*	**
2. *Eriogonum lonchophyllum*	*	0.59	30.00	100	59	*	**
3. *Gutierrezia sarothrae*	*	0.56	7.50	25	56	*	**
4. *Agropyron trachycaulum*	*	0.49	12.50	25	49	*	**
5. *Haplopappus nuttallii*	*	0.44	15.00	25	44	*	**
6. *Bromus tectorum*	*	0.30	5.00	50	30	*	**
7. *Phlox hoodii*	*	0.19	7.50	25	19	*	**
8. *Phlox* sp.	*	0.16	10.00	25	16	*	**
9. *Sitanion longifolium*	*	0.08	2.50	25	8	*	**
10. *Penstemon* sp.	*	0.02	5.00	25	2	*	**
11. *Cryptantha sericea*	*	0.01	5.00	25	1	*	**
12. *Cirsium* sp.	*	0.01	2.50	25	1	*	
All Species		3.72			372		
MAY-JUNE 1975 (SUMMARY OF 2 TRANSECTS)							
1. *Eriogonum lonchophyllum*	2	0.28	35.00	50	28	*	**
2. *Artemisia frigida*	2	0.10	20.00	100	10	*	**
3. *Haplopappus nuttallii*	2	0.08	25.00	50	8	*	**
4. *Oryzopsis hymenoides*	2	0.08	15.00	100	8	*	**
5. *Sitanion longifolium*	2	0.08	5.00	50	8	*	**
6. *Ipomopsis* sp.	2	0.05	10.00	50	5	*	**
7. *Phlox longifolia*	2	0.05	10.00	50	5	*	**
8. *Chenopodium fremontii*	2	0.00	15.00	50	0	*	**
9. *Oenothera caespitosa*	2	0.00	15.00	50	0	*	**
All Species		0.72			72		

Table 3-7-38. (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 2 TRANSECTS)							
1. *Eriogonum lonchophyllum*	2	1.20	40.00	50	120	2.9	7.3
2. *Haplopappus nuttallii*	4	0.55	20.00	50	55	0.3	1.3
3. *Oryzopsis hymenoides*	5,2	0.25	25.00	100	25	*	**
4. *Chenopodium fremontii*	3	0.20	25.00	50	20	1.2	4.6
5. *Sphaeralcea coccinea*	2	0.15	10.00	50	15	0.7	7.0
6. *Oenothera caespitosa*	2	0.10	15.00	50	10	0.2	1.0
7. *Sitanion longifolium*	6,7	0.10	10.00	100	10	*	**
8. *Arenaria eastwoodiae*	2	0.00	5.00	50	0	0.1	1.0
9. *Cryptantha sericea*	2	0.00	5.00	50	0	0.1	1.0
All Species		2.55			255		
SEPTEMBER 1975 (SUMMARY OF 2 TRANSECTS)							
1. *Eriogonum lonchophyllum*	4	1.10	40.00	50	110	2.2	5.4
2. *Haplopappus nuttallii*	2	0.35	20.00	50	35	0.4	1.8
3. *Oryzopsis hymenoides*	2	0.30	25.00	100	30	*	**
4. *Sphaeralcea coccinea*	2	0.20	15.00	50	20	0.8	5.3
5. *Oenothera caespitosa*	2	0.10	20.00	50	10	0.2	1.0
6. *Chenopodium leptophyllum*	8	0.10	10.00	50	10	0.4	4.0
7. *Sitanion longifolium*	8	0.10	5.00	50	10	*	**
8. *Chenopodium fremontii*	7	0.05	10.00	50	5	0.3	3.0
All Species		2.30			230		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-39 Species encountered in the mature tree stratum in the riparian type for RBOSP

Species	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Basal Area m^2/ha
		MAY-JUNE, JULY, SEPTEMBER 1975 (SUMMARY OF TRANSECTS)				
1. Populus tremuloides	2.62	8.89	11	262	33	0.12

Table 3-7-40 Species encountered in the shrub-tree seedling stratum in the riparian type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative State (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology May-June	Phenology July	Phenology September	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/ha	Mean Volume (m^3)	Volume m^3/ha
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)										
1. Chrysothamnus viscidiflorus	*	*	*	1.57	25.00	25	157	451	*	**
2. Artemisia tridentata	*	*	*	0.44	18.75	25	44	910		
All Species				2.01			201	1361	*	**
MAY-JUNE, JULY, AND SEPTEMBER 1975 (SUMMARY OF TRANSECTS)										
1. Artemisia tridentata	2	2,3	5,6	4.91	57.78	67	491	1313	*	**
2. Populus tremuloides	*	*	2	3.34	11.11	11	334	198	*	**
3. Symphoricarpos oreophilus	2	2,5	2	3.09	57.78	67	309	1154	*	**
4. Rosa woodsii	2,3	2,3,4,5	2,6	2.84	53.33	56	284	965	0.02	0.79
5. Chrysothamnus nauseosus	2	2,3	4,5	2.49	68.89	89	249	559	*	**
6. Salix interior	*	2	*	2.20	17.78	22	220	44	*	**
7. Ribes aureum	2,3,4	5	6	1.98	46.67	67	198	239	*	**
8. Betulia fontinalis	*	5	*	1.74	11.11	11	174	24	*	**
9. Prunus virginiana	2	5	2,6	0.91	13.33	33	91	185	*	**
10. Ribes inerme	*	5	2,6	0.68	28.89	44	68	245	*	**
11. Amelanchier utahensis	3	5,6	2,6	0.61	26.67	56	61	135	*	**
12. Salix exigua	*	*	2	0.51	2.22	11	51	19	*	**
13. Swida sericea	*	5,6	*	0.15	4.41	11	15	4	*	**
14. Ribes cereum	3	6	6	0.06	11.11	33	6	22	*	**
15. Gutierrezia sarothrae	*	*	5	0.01	2.22	11	1	4	*	**
16. Sarcobatus vermiculatus	2	*	*	0.00	4.44	11	0	21	*	**
17. Atriplex confertifolia	*	*	2	0.00	2.22	11	0	61	*	**
18. Pachystima myrsinites	*	*	2	0.00	2.22	11	0	9	*	**
19. Pseudotsuga menziesii	*	*	*	0.00	2.22	11	0	2	*	**
All Species				25.52			2552	5203		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

Table 3-7-41 Species encountered in the herbaceous stratum in the riparian type for RBOSP

Phenology Key:
1. Emergent (herbaceous); leafing out (shrubs and trees)
2. Vegetative state (no evidence of reproductive stages)
3. Flower bud formation
4. Flowering
5. Seed formation
6. Seed maturity and dissemination
7. Seasonal senescence
8. Dead or dormant

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
OCTOBER 1974 (SUMMARY OF 4 TRANSECTS)							
1. Carex sp.	*	13.88	30.00	50	1388	*	**
2. Poa sp.	*	8.01	22.50	50	801	*	**
3. Scirpus acutus	*	7.14	27.50	75	714	*	**
4. Bromus inermis	*	4.18	10.00	25	418	*	**
5. Ranunculus cymbalaria	*	3.37	30.00	75	337	*	**
6. Rorippa nasturtium-aquaticum	*	2.04	7.50	25	204	*	**
7. Salsola iberica	*	1.98	10.00	25	198	*	**
8. Erigeron sp.	*	1.87	12.50	25	187	*	**
9. Plantago sp.	*	1.68	20.00	50	168	*	**
10. Triglochin maritima	*	1.39	7.50	25	139	*	**
11. Agropyron trachycaulum	*	1.09	10.00	25	109	*	**
12. Hordeum sp.	*	1.05	27.50	75	105	*	**
13. Eragrostis sp.	*	0.76	5.00	25	76	*	**
14. Rumex crispus	*	0.45	12.50	25	45	*	**
15. Artemisia ludoviciana	*	0.40	2.50	25	40	*	**
16. Taraxacum officinale	*	0.35	7.50	25	35	*	**
17. Bromus ciliatus	*	0.28	5.00	25	28	*	**
18. Chenopodium sp.	*	0.27	17.50	50	27	*	**
19. Senecio sp.	*	0.25	2.50	25	25	*	**
20. Elymus cinereus	*	0.21	2.50	25	21	*	**
21. Agropyron smithii	*	0.20	7.50	50	20	*	**
22. Malva sp.	*	0.12	2.50	25	12	*	**
23. Poa interior	*	0.11	2.50	25	11	*	**
24. Agropyron desertorum	*	0.09	2.50	25	9	*	**
25. Bromus tectorum	*	0.06	7.50	50	6	*	**
26. Lepidium perfoliatum	*	0.04	2.50	25	4	*	**
27. Typha latifolia	*	0.02	2.50	25	2	*	**
28. Stipa sp.	*	0.01	2.50	25	1	*	**
Unknown Crucifereae	*	0.10	2.50	25	10	*	**
All Species		51.40			5140		

Table 3-7-41 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
		MAY-JUNE 1975 (SUMMARY OF 4 TRANSECTS)					
1. Agropyron repens	2	36.26	70.00	75	3626	*	**
2. Poa pratensis	2,4	3.20	40.00	75	320	*	**
3. Taraxacum officinale	2,3	1.91	45.00	100	191	*	**
4. Carex sp.	2	1.63	7.50	50	163	*	**
5. Artemisia ludoviciana	2	1.13	22.50	25	113	*	**
6. Elymus cinereus	2	0.50	2.50	25	50	*	**
7. Juncus balticus	2	0.40	7.50	75	40	*	**
8. Descurainia pinnata	5,2,3	0.38	30.00	50	38	*	**
9. Zygadenus venenosus	4	0.25	2.50	25	25	*	**
10. Achillea lanulosa	2	0.23	5.00	25	23	*	**
11. Artemisia dracunculus	2	0.23	5.00	25	23	*	**
12. Bromus tectorum	4	0.20	12.50	25	20	*	**
13. Lactuca serriola	2	0.13	2.50	25	13	*	**
14. Chaenactis douglasii	2	0.08	7.50	25	8	*	**
15. Bromus inermis	2	0.08	2.50	25	8	*	**
16. Chenopodium fremontii	2	0.03	15.00	50	3	*	**
17. Sisymbrium linifolium	3	0.03	2.50	25	3	*	**
18. Artemisia frigida	2	0.00	5.00	25	0	*	**
19. Chenopodium album	2	0.00	2.50	25	0	*	**
20. Erigeron eatonii	2	0.00	2.50	25	0	*	**
21. Physaria floribunda	4	0.00	2.50	25	0	*	**
Unknown	*	3.24	22.50	**	324	*	**
All Species		49.91			4991		
		JULY 1975 (SUMMARY OF 5 TRANSECTS)					
1. Agropyron repens	2	13.96	18.00	20	1396	*	**
2. Agropyron smithii	5	13.20	24.00	40	1320	*	**
3. Poa pratensis	4,5	7.18	42.00	80	718	*	**
4. Elymus cinereus	5	7.00	14.00	20	700	*	**
5. Agropyron sp.	4,5	3.80	8.00	40	380	*	**
6. Glyceria striata	4,5	1.28	10.00	40	128	*	**
7. Carex vernacula	2,5	1.20	4.00	40	120	*	**
8. Carex sp.	5	1.00	4.00	20	100	*	**
9. Bromus inermis	2	0.94	4.00	20	94	*	**
10. Ranunculus cymbalaria	2,4,5	0.80	12.00	80	80	0.6	4.8

Table 3-7-41 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
JULY 1975 (SUMMARY OF 5 TRANSECTS) CONTINUED							
11. Taraxacum officinale	2,6	0.72	36.00	100	72	2.2	6.1
12. Carex nebraskensis	2	0.70	2.00	20	70	*	**
13. Smilacina stellata	5,6	0.60	2.00	20	60	0.3	15.0
14. Hordeum jubatum	5	0.46	4.00	40	46	*	**
15. Descurainia pinnata	6,5	0.34	12.00	40	34	1.5	12.5
16. Kochia iranica	2	0.32	4.00	20	32	2.2	56.0
17. Agropyron trachycaulum	4,5	0.32	12.00	20	32	*	**
18. Juncus balticas	4,5	0.24	6.00	40	24	*	**
19. Solidago sp.	2	0.20	2.00	20	20	0.4	19.0
20. Chenspedium album	3,4	0.18	8.00	40	18	0.2	2.5
21. Achillea lanulosa	4,5,2	0.14	10.00	40	14	0.4	3.6
22. Hordeum brachyantherum	5	0.10	4.00	40	10	*	**
23. Sporobolus airoides	4,5	0.10	4.00	40	10	*	**
24. Rumex utahensis	3	0.10	2.00	20	10	0.0	1.0
25. Chenopodium leptophyllum	4	0.08	2.00	20	8	0.1	3.0
26. Chenopodium fremontii	2,4	0.06	16.00	40	6	0.4	2.3
27. Lactuca serriola	2	0.06	4.00	40	6	0.1	2.0
28. Agropyron spicatum	5	0.04	2.00	20	4	*	**
29. Geranium richardsoni	2	0.04	2.00	20	4	0.1	3.0
30. Galium boreale	2	0.02	2.00	20	2	0.1	2.3
31. Gutierrezia sarothrae	2	0.02	2.00	20	2	0.0	1.0
32. Juncus saximontanus	4,5	0.02	2.00	20	2	*	**
33. Cirsium arvense	2	0.00	2.00	20	0	0.0	1.0
34. Cirsium sp.	2	0.00	2.00	20	0	0.0	1.0
35. Poa ampla	4,5	0.00	2.00	20	0	*	**
36. Unknown	*	1.86	18.00	**	186	*	**
All Species		57.08			5708		

Table 3-7-41 (Continued)

Species	Phenology	Percent Cover	Percent Frequency	Constancy	Cover m^2/ha	Density #/Quad.	Sociability
SEPTEMBER 1975 (SUMMARY OF 3 TRANSECTS)							
1. Elymus cinereus	7,5	34.47	56.67	67	3447	*	**
2. Agropyron repens	6,2	25.30	46.67	67	2530	*	**
3. Erigeron speciosus	4,5	5.03	36.67	100	503	26.8	73.1
4. Juncus arcticus	6	4.37	10.00	67	437	*	**
5. Agropyron smithii	2	3.80	20.00	67	380	*	**
6. Hordeum brachyantherum	7	1.93	6.67	33	193	*	**
7. Poa nemoralis	6	1.90	16.67	33	190	*	**
8. Carex lanuginosa	5,2	1.67	13.33	100	167	*	**
9. Ranunculus cymbalaria	2,6	1.13	13.33	67	113	4.5	34.0
10. Senecio spartioides	6	0.87	6.67	33	87	7.5	112.5
11. Solidago multiradiata	2	0.67	6.67	67	67	3.4	51.0
12. Chenopodium album	8,5	0.63	10.00	67	63	0.3	2.7
13. Chenopodium hybridum	4,5	0.57	20.00	67	57	0.4	2.2
14. Poa pratensis	7,2	0.57	10.00	67	57	*	**
15. Sitanion longifolium	7	0.47	6.67	67	47	*	**
16. Kochia iranica	4	0.47	3.33	33	47	4.0	120.0
17. Eleocharis macrostachya	6	0.33	3.33	33	33	*	**
18. Taraxacum officinale	2	0.30	23.33	100	30	1.2	5.1
19. Descurainia pinnata	8	0.17	10.00	67	17	0.2	2.3
20. Plantago major	2	0.10	3.33	33	10	0.1	2.0
21. Triglochin maritima	6	0.07	3.33	33	7	0.1	2.0
22. Carex nebraskensis	2	0.03	3.33	33	3	*	**
23. Chenopodium fremontii	3	0.03	3.33	33	3	0.1	3.0
24. Sporobolus airoides	6	0.03	3.33	33	3	*	**
25. Lepidium montanum	2	0.03	3.33	33	3	0.0	1.0
All Species		84.94			8494		

*Value not recorded in the field because of sampling procedure or absence of species.

**Value cannot be calculated because of absence of data.

B. Grazing Exclosure

1. Objectives - The grazing exclosure established on Tract C-a is designed to demonstrate and monitor vegetation responses to the exclusion of particular groups of grazing or browsing herbivores. Various forage species can be expected to respond to protection according to their position in the hierarchy of consumer preferences. Thus, the most desirable components of the plant community should react most dramatically to a release from the restraints exercised upon them by certain herbivores.

Quantitative and qualitative study techniques and photoplots will be utilized to measure these responses. However, all techniques will focus on incremental forage production resulting from the degree or quality of protection being afforded.

Careful evaluation of data obtained during this study should reveal several important aspects of ecosystem interactions. It may be possible to determine plant species preferences for each class of herbivore. Determination of the relative importance of individual plant species to wildlife and to domestic and feral livestock will facilitate defining priorities for reestablishing plant species after disturbance. The protected exclosure will serve as a basis for comparisons to similar communities outside the exclosure, providing a means for improving carrying capacity evaluations and land management decisions in the region.

2. Methods

a. Data Collection

1) Exclosure Design and Sampling Techniques - An exclosure has been situated on Tract C-a in the southwest quarter. Dominant browse species on the exclosure site are sagebrush (*Artemisia tridentata*) and bitterbrush (*Purshia tridentata*). Snowberry (*Symphoricarpos oreophilus*) and serviceberry (*Amelanchier alnifolia*) are fairly common in the area.

Substantial use by livestock and wildlife was evidenced by browse condition and density of fecal groups at the site. The exclosure encompasses 1.21 ha (3 A) measuring 190.9 m (626 ft) X 63.6 m (208.7 ft) (Figure 3-7-15). The exclosure contains three compartments or sections constructed to prevent access by particular groups of herbivores (National Academy of Sciences - National Research Council, 1962). The largest compartment contains 0.61 ha (1.5 A) and is constructed of standard 4-strand barbed wire fence (with a wooden rail as the top strand) on three sides of the compartment. This compartment excludes domestic livestock and wild horses but allows free access to big game able to leap the fence and small wildlife that can enter through or under the wire. The other half of the exclosure was constructed of 2.74 m (9 ft) high woven-wire. The second compartment, located within this half and enclosing 0.4 ha (1 A), excludes big game and livestock but not smaller mammals. The third compartment, 0.2 ha (0.5 A) in size, with the addition of 0.91 m (3 ft) poultry wire buried to a depth of 24.5 cm (10 in.), was designed to prevent entry by all mammalian herbivores including lagomorphs and other small mammals. Insects could not be excluded and their populations within the protected plots may be disproportionately higher than outside. Herbage consumption by insects, however, would likely not be under normal circumstances.

In addition to the three compartments within the exclosure, one study area commensurate in size to the largest exclosure compartment is established outside the exclosure. This comprises the control or "non-treatment" plot subjected to normal foraging pressures. The site is contiguous to the exclosure and permanently marked by metal stakes.

A minimum 7.62 m (25 ft) buffer zone between the fence and sampling areas is strictly observed in an attempt to reduce several of the prejudicial factors inherent in exclosure studies. Fences intercept precipitation and accumulate snow drifts, thereby significantly altering soil moisture conditions below and adjacent to them. Site disturbance during fence construction may have long-lasting effects. The fences can affect light conditions, soil conditions, and seed dispersal, and thereby plant establishment and distribution patterns. Sampling is undertaken once each year near the completion of the growing season in late July or early August. Different sampling techniques are implemented for each of the three principal strata of the plant community.

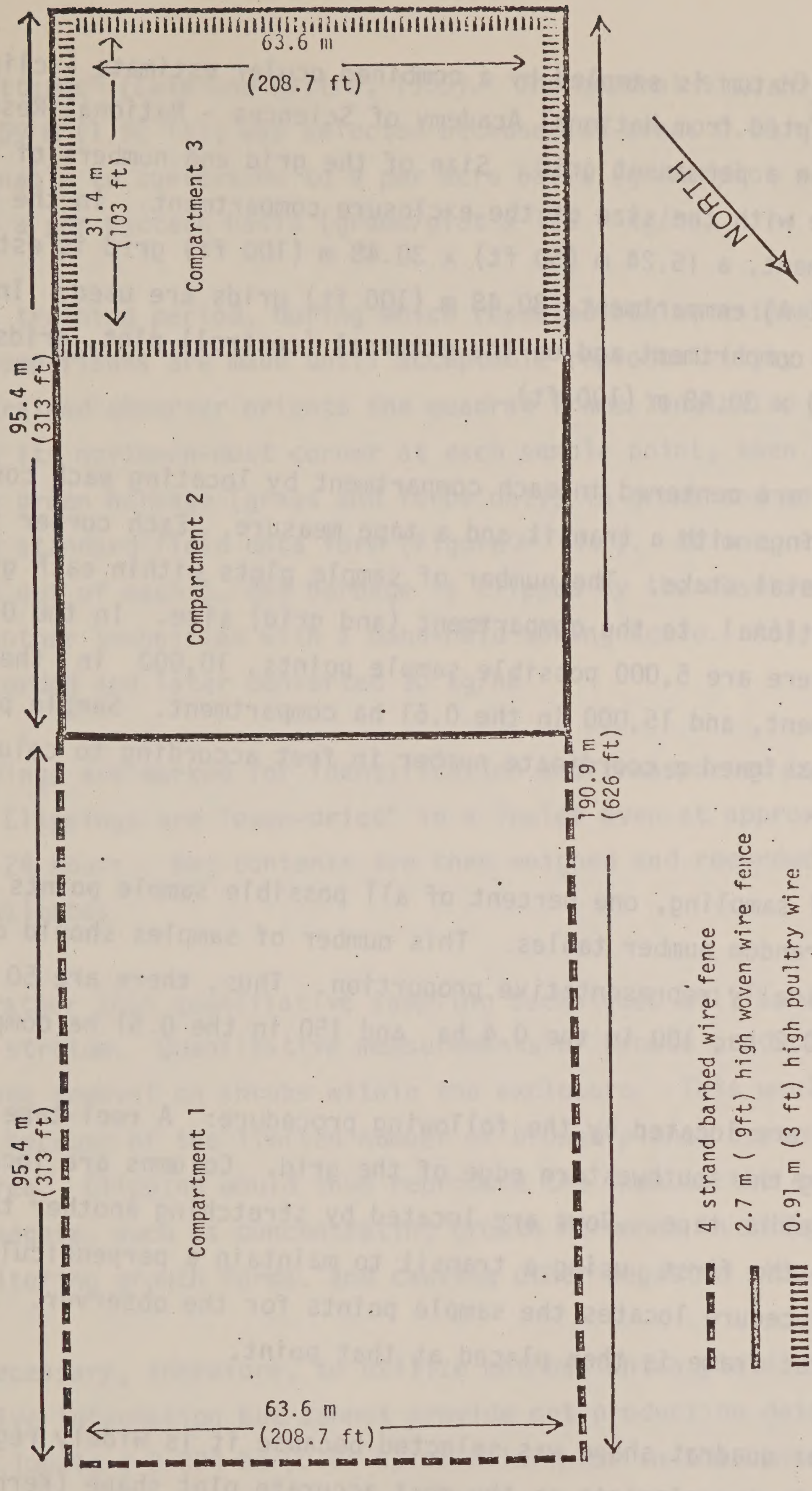


Figure 3-7-15. Design of the grazing exclosure used for RBOSP

The grass-forb stratum is sampled by a combined ocular estimate - clipped plot method (adapted from National Academy of Sciences - National Research Council, 1962) on a permanent grid. Size of the grid and numbers of samples are commensurate with the size of the exclosure compartment. In the 0.2 ha (0.5 A) compartment, a 15.24 m (50 ft) x 30.48 m (100 ft) grid is established. In the 0.4 ha (1 A) compartment, 30.48 m (100 ft) grids are used. In the 0.61 ha (1.5 A) compartment and on the external (control) plot, grids measure 45.72 m (150 ft) x 30.48 m (100 ft).

Permanent grids are centered in each compartment by locating each corner via cross-sightings with a transit and a tape measure. Each corner is then marked with a metal stake. The number of sample plots within each grid is directly proportional to the compartment (and grid) size. In the 0.2 ha compartment, there are 5,000 possible sample points, 10,000 in the 0.4 ha compartment, and 15,000 in the 0.61 ha compartment. Sample plot locations are assigned a coordinate number in feet according to column and row.

Prior to actual sampling, one percent of all possible sample points is selected from random number tables. This number of samples should constitute a statistically representative proportion. Thus, there are 50 sample points in the 0.2 ha, 100 in the 0.4 ha and 150 in the 0.61 ha compartment.

Sampling plots are located by the following procedure: A reel-tape is stretched along the southwestern edge of the grid. Columns are located along this baseline tape. Rows are located by stretching another tape at a right angle to the first using a transit to maintain a perpendicular position. This procedure locates the sample points for the observer. A rectangular quadrat frame is then placed at that point.

The rectangular quadrat shape was selected because it is widely regarded by quantitative plant ecologists as the most accurate plot shape (Kerhsaw, 1966; and Grieg-Smith, 1964). "Comparative studies have shown that relatively long plots are more efficient than isodiametric plots as sampling units, especially when some elements of the vegetation are highly aggregated in their

occurrence patterns" (Cain and Castro, 1959). The quadrat size [0.15 m (0.5 ft) x 0.59 m (1.92 ft)] was selected because its area, 0.09 m^2 (0.96 sq ft) is amenable to conversion to a per acre basis (grams/plot x 100 = lbs/A), or to a per hectare basis (grams/plot x 113 = kg/ha).

After a short training period, during which repeated ocular estimates followed by clipping comparisons are made until acceptable reproducibility of results is achieved, a trained observer orients the quadrat frame lengthwise along the row tape with its northern-most corner at each sample point, then ocularly estimates the green herbage (grass and forbs only) in grams and records an estimate on a standard field data form (Figure 3-7-16). At one randomly selected plot out of each 5, the herbage is clipped by the observer and weighed by another technician with a hand-held spring scale. All plot clippings are recorded and later converted to kg/ha.

Bags of clippings are marked for identification and transported to the ECI laboratory. Clippings are "oven-dried" in a Thelco oven at approximately 70°C for at least 24 hours. Bag contents are then weighed and recorded to provide dry weight estimates.

Qualitative rather than quantitative sampling techniques will be used on the shrub stratum. Quantitative measurements of browse production would require herbage removal on shrubs within the exclosure. This would introduce extreme bias because of the limited number of browse plants occurring within the sample area. Clipping would thus reproduce the impacts the exclosure is designed to negate, such as concentrating growth hormones in clipped areas of the plant, altering growth forms, and causing other negative side-effects.

It becomes necessary, therefore, to utilize methods which yield useful relative and qualitative information but cannot provide net production data. The method chosen is to locate a 0.004 ha (0.01 A) circular plot in the center of each grid. The disadvantages inherent in the shape of the plot are mostly offset by the large size of the plot in proportion to the grid area; a large percentage of the area is sampled (Cain and Castro, 1959).

A stake is driven into the center of the permanent grid and another near the perimeter of the plot to mark a starting point. A full circle is then circumscribed with a 3.6 m (11.8 ft) radius. Every shrub rooted within the plot is recorded on a field data form (Figure 3-7-17) as to species, maximum height, mean crown diameter, percent of the canopy that is alive, and percent of the plant available to a potential browsing animal.

Maximum shrub height is measured with a pocket tape and recorded in centimeters as the greatest distance of live portions of the plant from ground level. Mean diameter is the average of the greatest and least diameters of the shrub and is also measured with a pocket tape placed horizontally at the level of maximum canopy development. Percent of the shrub which is alive and percent available as browse are both ocular estimates.

The tree canopy need be measured only at the beginning and end of the study period or at infrequent intervals if the study is of long duration. The simplest procedure available is to measure the canopy intercepting a line which traces the perimeter of the established grass-forb grid. Tapes are stretched between corners of each grid and the distances of canopies intercepting those tapes recorded by species.

The importance of pinyon and juniper as a component of wintering mule deer diets has not been adequately established. Many researchers credit the species with providing large quantities of browse during critical winter periods (R. Krager, Colorado Division of Wildlife's Little Hills Experimental Station, personal communication, 1974). The appearance of pinyon and juniper trees in the Piceance Basin seems to support this supposition. Many large trees are browsed to a uniform height (high line level) of about 1.83 m (6 ft). The importance of these species will be reflected in a minor change to the standard line-intercept procedure implemented to measure browsing effects on pinyon and juniper. Canopy intersecting the line that is less than "high-line level" or 1.83 m high (De Vos and Mosby, 1971) will be recorded separately (Figure 3-7-18). The proportion of lower canopy can be expected to increase in the protected compartments of the exclosure if those plants are ordinarily browsed heavily by deer.

2) Photoplots - "Photographic plots provide a visual record of change or lack of change in the vegetation cover. They are useful for illustrative purposes but in themselves do not provide a quantitative measure in the vegetation. When used in conjunction with quantitative methods they become valuable records" (National Academy of Sciences - National Research Council, 1962).

At the exclosure, up to three individual shrubs in the major browse species (sagebrush and bitterbrush) present are selected for photographic documentation in each sample grid (ideally for a total of 12 individuals/species at the exclosure site). Plants selected are healthy and of medium size. During the first photo-sampling seasons, shrubs are permanently marked.

A white-painted plywood sheet marked with a one-inch grid of black lines and cut in two and hinged to facilitate handling is used as a backdrop for photographing each shrub (modified from Springfield, 1974).

In the first season, photoplots are permanently located by driving rebar stakes at points directly below the camera and at corners of the backdrop sheet. In succeeding years, plots are relocated and rephotographed by use of those reference points. Photographs are taken each year unless comparison of the first two years' photographs indicates that extended sampling intervals would be more efficient. Sampling is timed to correlate with the important phenological stage of the shrubs in mid-summer, at the completion of twig elongation.

b) Data Analysis

1) Grass-forb Stratum - Ocular estimates are corrected to dry weights and also corrected for errors in ocular estimation by the following formula:

$$\text{Ocular estimate} \times ((1-(\bar{x}_1/\bar{y}_1)) + 1) \times ((1-(\bar{y}_1/\bar{y}_2)) + 1)$$

where: $\bar{x}_1$ = ocular estimates mean
$\bar{y}_1$ = clipped weights mean
$\bar{y}_2$ = dried weights mean

A complete analysis of variance (Snedecor and Cochran, 1967) was performed on the corrected data to determine if site difference exists between the sampling grids.

2) Shrub Stratum - For each shrub species encountered during shrub sampling within the grazing exclosure, the following parameters are estimated: mean, variance, and range (Snedecor and Cochran, 1967) for maximum shrub height, average crown diameter of each individual, percent alive and percent available of each species. Total area (m^2) covered by each shrub species = $\Sigma 1/4 \pi (D_i/100)^2$ where D_i is the mean crown diameter of individual i of a particular species. Absolute area covered (m^2/ha) for each species = total area covered/0.004.

3) Tree Stratum - For each tree species encountered on the tree transect, percent cover was computed by the following formula:

$$\frac{\Sigma(I_2 - I_1)_i}{\text{Total length of transect}}$$

where: $(I_2 - I_1)$ = intercept distance

3. Data Summary - In the grass forb stratum, rodent-proof compartments yielded a mean of 0.90 g/sample or 101.93 kg/ha of oven-dried herbage. The deer-cattle proof compartment yielded 4.35 g/sample or 491.10 kg/ha, and the compartment excluding only cattle yielded 3.21/sample or 363.04 kg/ha. The "control" or unfenced, area yielded 2.54 g/sample or 286.71 kg/ha.

In the shrub stratum, the 0.01 acre plot within the rodent-proof compartment contained 1.00 m^2 *Artemisia tridnetata* for an absolute area of 249.39 m^2/ha. The deer-proof compartment shrub plot contained a total area of 2.72 m^2 *Artemisia tridentata* for an absolute area of 680.35 m^2/ha; 0.44 m^2 *Chrysothamnus nauseosus* for an absolute area of 109.07 m^2/ha; 0.01 m^2 *C. viscidiflorus*, for an absolute area of 1.95 m^2/ha. The cattle-proof compartment shrub plot contained

0.14 m^2 Amelanchier utahensis, for an absolute area of 35.82 m^2/ha; 4.03 m^2 Artemisia tridentata, for an absolute area of 1006.66 m^2/ha; 1.04 m^2 Chrysothamnus nauseosus, for an absolute area of 260.72 m^2/ha; 0.32 m^2 Juniperus osteosperma, for an absolute area of 80.52 m^2/ha; 0.05 m^2 Pinus edulis, for an absolute area of 12.27 m^2/ha; and 1.52 m^2 Purshia tridentata for an absolute area of 379.57 m^2/ha. The "control" plot contained 0.10 m^2 Amelanchier utahensis, for an absolute area of 24.05 m^2/ha; 3.82 m^2 Artemisia tridentata for an absolute area of 954.20 m^2/ha; 2.67 m^2 Juniperus osteosperma for an absolute area of 667.85 m^2/ha; 1.08 m^2 Pinus edulis, for an absolute area of 269.57 m^2/ha; and 3.10 m^2 Purshia tridentata, for an absolute area of 773.87 m^2/ha.

In the tree canopy stratum, the periphery of the sampling grid in the rodent-proof compartment intercepted 168.5 cm of juniper (Juniperus osteosperma) and 302.4 cm of pinyon (Pinus edulis) above "high line level" (1.83 m). Juniper and pinyon intercepting the line below "high line level" totalled 77.2 cm and 29.1 cm, respectively. In the deer-proof compartment, the upper canopy of the grid perimeter was intercepted by 89.8 cm pinyon. The lower canopy consisted of 152.8 cm pinyon and 78.4 cm juniper. The perimeter of the cattle-proof compartment grid intercepted 156.7 cm of pinyon and 170.1 cm juniper in the upper canopy, 224.4 cm pinyon and 135.8 cm pinyon in the lower canopy. Along the perimeter of the grid in the control area, 156.3 cm pinyon and 22.1 cm juniper were intercepted in the upper canopy, and 102.8 cm pinyon and 59.1 cm juniper in the lower canopy.

Shrub photoplot photos are on file as baseline data for comparison with results from future sampling periods.

4. Discussion - The data contained in this section are baseline material intended for comparison with data from future years. It is important to recognize that initial differences between sample grids may exercise considerable influences on the responses elicited from the various treatments. Current differences can be attributed to slight variations in slope and aspect within and between the sample plots. It should be understood that these influences will exert differential pressures on the responses of each sample site and that these responses will not necessarily be directly proportionate to the

degree of protection from grazing and browsing. The responses of sample sites to degrees of release from grazing pressures will be measured in future years with the aforementioned considerations in mind.

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Figures for the

Grazing Exclosure Section

OCULAR ESTIMATE - CLIPPED PLOTS FOR GRASS-FORBS

Project________________________Site________________________Date____________

Observer____________________________Page________ of ________

Ocular Estimate	Clipped Weight	Ocular Estimate	Clipped Weight	Ocular Estimate	Clipped Weight	Ocular Estimate	Clipped Weight
1		26		51		76	
2		27		52		77	
3		28		53		78	
4		29		54		79	
5		30		55		80	
6		31		56		81	
7		32		57		82	
8		33		58		83	
9		34		59		84	
10		35		60		85	
11		36		61		86	
12		37		62		87	
13		38		63		88	
14		39		64		89	
15		40		65		90	
16		41		66		91	
17		42		67		92	
18		43		68		93	
19		44		69		94	
20		45		70		95	
21		46		71		96	
22		47		72		97	
23		48		73		98	
24		49		74		99	
25		50		75		100	

118/060175

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Figure 3-7-16. Data sheet for recording ocular estimates and clipped weights of the grass-forb stratum for RBOSP.

DATA SHEET FOR 0.004 HECTARE SHRUB PLOTS

Project__________________________ Site__________________________ Date______________

Observer(s)____ Page ______ of ______

Species	Maximum Height	Mean Crown Diameter	Percent Alive	Percent Available	Remarks

125/060175

ecology consultants, Inc.

Figure 3-7-17. Data sheet for 0.004 hectare shrub plots for RBOSP

File No.____________
Sheet ______ of ________

GRAZING EXCLOSURE DATA SHEET
MATURE TREE STRATUM

Field Analyst________________ Project__________ Date____________
Exclosure________________ Compartment____________ (upper) (lower) canopy

Species	Intercepts (m) I_1	I_2	I_1	I_2	I_1	I_2	I_1	I_2	I_1	I_2

117/060175 *ecology consultants, inc.*

Figure 3-7-18. Data sheet for grazing exclosure mature tree stratum for RBOSP

C. Range Analysis

1. Objectives - Range, browse, and soil condition and trend are the principal criteria influencing grazing management decisions on federally administered lands. Such field studies have not been undertaken in the area of Tract C-a since a 1941 Bureau of Land Management range analysis.

This program, therefore, was primarily designed to determine the range condition (the current condition of the range in relation to the potential of which the site is capable) of all circumscribed plant communities that have been mapped for Tract C-a and adjacent areas. Trend, the inclination of range condition toward improvement, stabilization, or deterioration, was also determined. Concurrently, browse and soil conditions and trend were evaluated.

Since similar methodologies have been used, the condition and trend studies presented herein relate to and integrate with separate studies conducted by state and federal agencies. Data obtained during these studies permit practical evaluations affecting land management decisions.

2. Methods

a. Data Collection - The procedures used to establish vegetation condition and trend were consistent with common range analysis practices as described in detail in United States Department of Agriculture Forest Handbook 2209.21R3 (Range Environmental Analysis Handbook, 1970). Maps on which vegetation types were delineated by remote sensing techniques were used to locate field sampling locations. Each circumscribed type was ground-checked and the dominant vegetation verified.

Each delineated vegetation type estimated to be greater than 16 ha (40 A) but smaller than one-half section (128 ha) in size was sampled by means of one paced transect. In larger types, transects were placed at an approximate

rate of one per one-half section longitudinal to and centered within the shape of the type. A total of 137 transects, each 400 paces in length, were established. Sampling points along a transect were located at 4-step intervals for grass-forb data collection (100 sampling points) and at 16-step intervals for browse data collection (25 sampling points).

At each grass-forb sample point, a loop 1.91 cm (0.75 in.) in diameter was placed at a mark on the toe of a boot and hits on rock, litter, bare soil, and vegetation were recorded on a standard field data form (Figure 3-7-19). Hits on vegetation were recorded by individual plant species. When the loop did not hit a perennial plant, the nearest plant within a 180° arc of the loop was tallied. Each plant, depending on its response to grazing or disturbance, was ecologically classified as a decreaser (desirable), increaser (intermediate), or invader (undesirable). These designations were checked and verified by Dr. Phil Sims of the Range Science Department, Colorado State University; Dr. Robert Hyde, a Colorado State University Range Extension specialist; and Mr. Tom K. Eamon, a Range Conservationist with the Denver Office of the Soil Conservation Service.

Plant vigor and current soil erosion, factors used in the range analysis, were visually evaluated and recorded (Figure 3-7-19). Vigor ratings were made only on available decreaser and increaser species and scored on a 0-10 scale.

The score was based on leaf length, number of seedstalks, and root system, which was correlated in size or extent to above-ground plant parts (Table 3-7-42). Current soil erosion was scored from 0 to 50 by the criteria listed in Table 3-7-43 . Vegetation and soil trends at each study site were also determined visually, based on guides presented in Table 3-7-44 .

At each browse sampling point, the nearest browse plant within a 180° arc of the loop was given an age and form class designation. These designations, based on criteria presented in Table 3-7-45 (Patton and Hall, 1966), were also recorded on the standard field data form (Figure 3-7-19).

b. Data Analysis

1) Range Condition - Range condition is described by a numeric rating based on a 100-point score. The rating is derived by summing weighted scores for species composition (54% of the final rating), forage cover (36%), and vigor (10%).

Species composition, the principal criterion on which range condition is based, was scored by summing the hits and tallies for all species within each classification group of decreasers, increasers, and invaders. These sums represent the percent composition for each group. Values must be adjusted for non-allowable species composition: if a species contributes more than a designated maximum percentage to total composition, the additional percentage is ignored. After such adjustment, the decreaser composition percent is multiplied by 2, increaser composition percent by 0.25 and invader composition percent by -1. Resulting values are summed. The final composition rate (0-54 points) is determined from this sum by the scale given in Table 3-7-46 .

The vegetation cover score (0-36 points) reflects actual plant occurrence along the transect. It is determined from the sum of hits for all forage plants by the rate presented in Table 3-7-47 . Vigor is rated by the method presented in Table 3-7-42.

2) Soil Stability Condition - A soil stability rating (0-100 points) is based on a combination of an erosion hazard score and current soil erosion. Both are given equal weights of 50 points. Erosion hazard is determined by the number of hits at transect sample points on bare soil, or gravel less than 1.9 cm (0.75 in.) in diameter. Hits on gravel larger than 1.9 cm in diameter are recorded as rocks. Erosion rating criteria are given in Table 3-7-48 . Current soil erosion is rated by the method given in section "a", Data Collection (Table 3-7-43).

3) Browse Condition and Trend - A numerical rating of browse condition is provided by determining the percentage of total plants on one transect that is lightly hedged (Form Class 1 & 4), moderately hedged (Form Class 2 & 5), and heavily hedged (Form Class 3 & 6). Hedging refers to the effect of large herbivore browsing on the natural growth form of a plant. Percentages are then checked against the browse scorecard (Table 3-7-49), and those that fall into more than one rate category within a hedging classification are entered in both (e.g., a value of 13% for Form Class 1 & 4 would be entered both in the Fair, 0-50, and the Poor, 0-25, categories). Finally, a numerical rating based on the one instance of percentages falling into two or more columns in one row is then recorded for each transect.

Browse trend is determined by using the difference between the number of young and decadent plants. A decadent browse plant is one which, regardless of age, exhibits dead or dying portions amounting to 25% or more of its total foliage. A numerical rating for browse trend is also provided in Table 3-7-49 .

4) Condition Classes and Mapping - At each transect, range and soil condition are designated by an adjective condition class ranging from very poor to excellent(Table 3-7-50).

Two different maps are used to summarize range analysis data. On one map, grass-forb and soil condition and trend at each transect are described by a series of symbols. For example, the notation PJ (Cemo) - Agti, Orhy $\frac{56F\uparrow}{48F\downarrow}$ would signify a vegetation type dominated by pinyon-juniper, with a *Cercocarpus montanus* shrub understory, and with *Agropyron trachycaulum* and *Oryzopsis hymenoides* as the most prevalent forage species. The grass-forb vegetation has a numerical rating of 56, which places it in a fair condition class with an upward trend. Soil condition has a numerical rating of 48, placing it in a fair condition class with a downward trend.

Transect designations and browse condition and trend are described by symbols on the second map. The symbol 1-66/G would indicate the 66th transect sampled by observer number 1. The browse condition would be good and the trend would be stable.

3. Data Summary - The study area covered approximately 35,269 acres (see Figures 3-7-20 and 3-7-21) and encompassed six major vegetation types; pinyon-juniper, sagebrush, mixed brush, upland meadow, aspen, Douglas-fir, and one variant of a major vegetation type, greasewood. These were distributed as follows: pinyon-juniper - 13,930 acres or 39.5% of the area; sagebrush - 11,853 acres or 33.6% of the area; mixed brush - 8,499 acres or 24.1% of the area; upland meadow 0 496 acres or 1.4% of the area; aspen - 313 acres or 0.9% of the area; Douglas-fir - 115 acres or 0.3% of the area; and greasewood (variant of sagebrush vegetation type) - 63 acres or 0.2% of the area (Table 3-7-51). The survey area was situated so as to encompass Tract C-a and the full spectrum of elevational zones and vegetation types which surround it. All acreage information is summarized in Table 3-7-51.

a. Range Condition and Trend - The major proportion (73.1%) of the study area, 25,823 acres, was in "Fair" condition (Table 3-7-52). Only 2.4% or 846 acres was classified in "Good" condition. Most of this, 631 acres, was in sagebrush communities, the remainder consisted on aspen and Douglas-fir vegetation types. A total of 8,609 acres or 24.4% of the area was placed in the "Poor" condition class. Pinyon-juniper (6,939A) and sagebrush (1,643A) sites contributed the largest proportions to this "poor" condition class.

No sites were in either the "Excellent" or "Very Poor" condition classes (Table 3-7-53). Range condition classification is predicated on the hypothesis that vegetation is a product of environment, subject to physical, edaphic, and biotic influences and limitations. Many western rangelands have never attained climax status because of one or more of these limitations. The great time involved to arrive at climax or "Excellent" condition precludes that condition from being a practical management objective (Stoddart & Smith, 1955).

Almost one-half of the study area, 48.5% or 17,100 acres was placed in the category of upward or improving range trend (Table 3-7-54). A majority of sites in all vegetation types except pinyon-juniper demonstrated upward

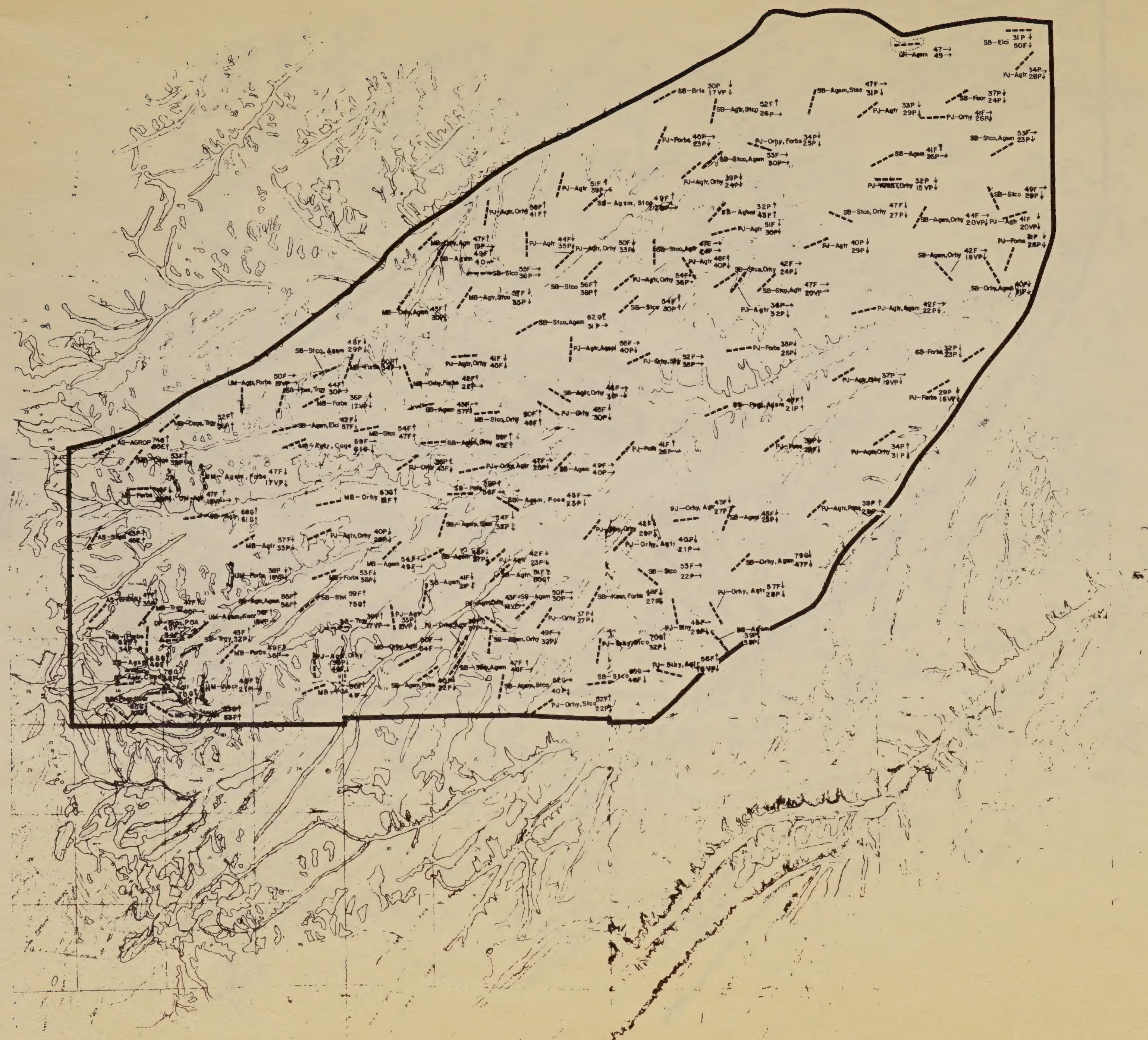
3. Data Summary - The study area covered approximately 35,269 acres (see Figures 3-7-20 and 3-7-21) and encompassed six major vegetation types: pinyon-juniper, sagebrush, mixed brush, upland meadow, aspen, Douglas-fir, and one variant of a major vegetation type, greasewood. These were distributed as follows: pinyon-juniper - 13,930 acres or 39.5% of the area; sagebrush - 11,853 acres or 33.6% of the area; mixed brush - 8,499 acres or 24.1% of the area; upland meadow 0,496 acres or 1.4% of the area; aspen - 253 acres or 0.9% of the area; Douglas-fir - 115 acres or 0.3% of the area; and greasewood (variant of sagebrush vegetation type) - 52 acres or 0.2% of the area (Table 3-7-51). The survey area was situated so as to encompass Tract C-a and the full spectrum of elevational zones and vegetation types which surround it. All acreage information is summarized in Table 3-7-51.

4. Range Condition and Trend - The major proportion (73.1%) of the study area, 25,823 acres, was in "Fair" condition (Table 3-7-52). Only 2.4% or 846 acres was classified in "Good" condition. Most of this, 637 acres, was in sagebrush communities, the remainder consisted on aspen and Douglas-fir vegetation types. A total of 8,509 acres or 24.4% of the area was placed in the "Poor" condition class. Pinyon-juniper (5,379A) and sagebrush (1,643A) sites contributed the largest proportions to this "poor" condition class.

No sites were in either the "Excellent" or "Very Poor" condition classes (Table 3-7-53). Range condition classification is predicated on the hypothesis that vegetation is a product of environment, subject to physical, edaphic, and biotic influences and limitations. Many western rangelands have never attained climax status because of one or more of these limitations. The great time involved to arrive at climax or "Excellent" condition precludes that condition from being a practical management objective (Stoddart & Smith 1955).

Almost one-half of the study area, 46.0% or 17,400 acres was placed in the category of upward or improving range trend (Table 3-7-54). A majority of sites in all vegetation types except pinyon-juniper demonstrated upward

Figure 3-7-20



[redacted]

RANGE CONDITION & TREND

UPPER CASE LETTERS INDICATES PLANT ASSOCIATION

PJ	PINYON-JUNIPER
SB	SAGEBRUSH
MB	MIXED BRUSH
UM	UPLAND MEADOW
AS	ASPEN
DF	DOUGLAS-FIR
GR	GREASEWOOD

COMBINATION OF UPPER AND LOWER CASE LETTERS INDICATES DOMINANT UNDERSTORY VEGETATION

AGROP	*AGROPYRON SPP.*
Agspi	*A. SPICATUM INERME*
Agsm	*A. SMITHII*
Agtr	*A. TRACHYCAULUM*
ARIST	*ARISTIDA SPP.*
Bran	*BROMUS ANOMOLUS*
Brte	*BROMUS TECTORUM*
BROMU	*BROMUS SPP.*
Cage	*CAREX GEYERI*
Elci	*ELYMUS CINEREUS*
Fear	*FESTUCA ARIZONICA*
Forbs	FORBS
Kocr	*KOELERIA CRISTATA*
Orhy	*ORYZOPSIS HYMENOIDES*
POA	*POA SPP.*
Pofe	*P. FENDLERIANA*
Popr	*P. PRATENSIS*
Pose	*P. SECUNDA*
Sihy	*SITANION HYSTRIX*
Stco	*STIPA COMATA*
STIPA	*STIPA SPP.*
Stvi	*S. VIRIDULA*
Trgy	*TRIFOLIUM GYMNOCARPON*

NUMERIC RATING

UPPER NUMBER REFERS TO RANGE CONDITION.

LOWER NUMBER REFERS TO SOIL CONDITION.

LETTER FOLLOWING NUMERIC RATINGS INDICATES RANGE TREND.

G	GOOD
F	FAIR
P	POOR

ARROW FOLLOWING LETTER INDICATES RANGE TREND.

↑ IMPROVING
→ NO APPARENT TREND
↓ DETERIORATING

0 1/2 1 MILE

Figure 3-7-21

[redacted]

VEGETATION MAP CODE

A	ASPEN
D	DOUGLAS-FIR
U	UPLAND MEADOW
M	MIXED BRUSH
P	PINYON-JUNIPER
S	SAGEBRUSH
C	SHADSCALE
B	RABBITBRUSH
G	GREASEWOOD
R	RIPARIAN
T	AGRICULTURAL

BROWSE CONDITION & TREND

NUMBERS TO THE LEFT OR ABOVE DASHED LINE —

FIRST NUMBER IS CODED NUMBER OF OBSERVER
SECOND NUMBER IS THE TRANSECT NUMBER.

LETTER TO THE RIGHT OR BELOW DASHED LINE INDICATES BROWSE CONDITION.

G	GOOD
F	FAIR
P	POOR

ARROW FOLLOWING LETTER INDICATES BROWSE TREND.

↑ IMPROVING
→ NO APPARENT TREND
↓ DETERIORATING

ABSENCE OF LETTER OR ARROW INDICATES NO BROWSE.

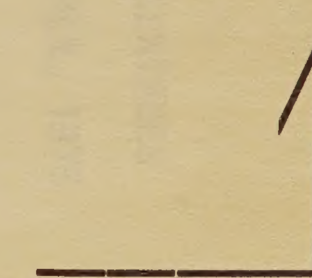


TABLE 3-7-51 . SUMMARY OF ACREAGES AND PERCENTAGES CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Type	Acreage	% of Total
Pinyon-juniper	13931	39.5
Sagebrush	11853	33.6
Mixed Brush	8499	24.1
Upland Meadow	496	1.4
Aspen	313	0.9
Douglas-Fir	115	0.3
Greasewood	63	0.2
	35269	

TABLE 3-7-52. RESULTS OF RANGE ANALYSIS STUDIES CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Condition	Trend	Acreage	% of Total
	Pinyon-Juniper		
Fair	up	571	1.6
Fair	stable	449	1.3
Fair	down	5981	17.0
Poor	up	38	0.1
Poor	stable	81	0.2
Poor	down	6820	19.3
		13940	
	Sagebrush		
Good	up	353	0.1
Good	down	277	0.8
Fair	up	6566	18.6
Fair	stable	1791	5.1
Fair	down	1221	3.5
Poor	up	698	2.0
Poor	stable	-	-
Poor	down	945	2.7
		11851	
	Mixed Brush		
Fair	up	8130	23.0
Fair	stable	369	1.0
		8499	
	Upland Meadow (Balds)		
Fair	up	348	1.0
Fair	stable	100	0.3
Fair	down	21	0.1
Poor	down	27	0.1
		496	
	Aspen		
Good	up	133	0.4
Fair	up	180	0.5
		313	

Table 3-7-52 . (Continued)

Condition	Trend	Acreage	% of Total
	Douglas-Fir		
Good	up	82	0.2
Fair	stable	33	0.1
		115	
	Greasewood		
Fair	stable	63	0.2
		63	

TABLE 3-7-53 . SUMMARY OF RANGE CONDITION CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Condition Class	Acreage	% of Total
	Pinyon-Juniper	
Excellent	0.0	--
Good	0.0	--
Fair	7001.0	19.8
Poor	6939.0	19.6
Very Poor	0.0	--
	Sagebrush	
Excellent	0.0	--
Good	631.0	1.8
Fair	9578.0	27.1
Poor	1645.0	4.7
Very Poor	0.0	--
	Mixed Brush	
Excellent	0.0	--
Good	0.0	--
Fair	8499.0	24.1
Poor	0.0	--
Very Poor	0.0	--
	Upland Meadow	
Excellent	0.0	--
Good	0.0	--
Fair	448.0	1.3
Poor	48.0	0.1
Very Poor	0.0	--
	Aspen	
Excellent	0.0	--
Good	133.0	0.4
Fair	180.0	0.5
Poor	0.0	--
Very Poor	0.0	--
	Douglas-Fir	
Excellent	0.0	--
Good	82.0	0.2
Fair	33.0	0.1
Poor	0.0	--
Very Poor	0.0	--

Table 3-7-53. (Continued)

Condition Class	Acreage	% of Total
	Greasewood	
Excellent	0.0	--
Good	0.0	--
Fair	63.0	0.2
Poor	0.0	--
Very Poor	0.0	--
	Total Area	
Excellent	0.0	--
Good	846.0	2.4
Fair	25802.0	73.1
Poor	8621.0	24.4
Very Poor	0.0	--

TABLE 3-7-54 . SUMMARY OF RANGE TREND CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR ROBSP DURING SUMMER, 1975

Trend	Acreage	% of Total
	Pinyon-Juniper	
Up	609	1.7
Stable	530	1.5
Down	12801	36.3
	Sagebrush	
Up	7618	21.6
Stable	1791	5.1
Down	2442	6.9
	Mixed Brush	
Up	8130	23.0
Stable	369	1.0
Down	0	-
	Upland Meadow.	
Up	348	1.0
Stable	100	0.3
Down	48	.0.1
	Aspen	
Up	313	0.9
Stable	0	-
Down	0	-
	Douglas-Fir	
Up	82	0.2
Stable	33	0.1
Down	0	-
	Greasewood	
Up	0	-
Stable	63	0.2
Down	0	-
	Total Area	
Up	17100	48.5
Stable	2876	8.2
Down	15291	43.4

trend. Sites totalling 2,886 acres or 8.18% of the area exhibited stability or no apparent trend. The areas assigned a downward or deteriorating trend encompassed 15,291 acres or 43.4% of the total. The greatest proportion of deteriorating rangelands (12,801 acres) were in the pinyon-juniper vegetation type (Table 3-7-54).

b. Soil Condition and Trend - Soil condition and trend is related closely to the amount of ground cover including vegetation, rocks, and litter relative to the amount of bare ground.

Only 133 acres or 0.4% of the study area were found to be in the "Excellent" condition class (Table 3-7-55). All of these were in the aspen vegetation type. A mere 746 acres or 2.1% of the area were in "Good" condition. Sites in "Good" condition were found in the sagebrush, aspen, and Douglas fir types. "Fair" soil condition was found on 2,805 acres or 7.9% of the area. Most of the soils within the study area, 86.7% or 30,573 acres, were determined to be in the "Poor" condition class. Only 2.9% of the area, 1,010 acres, was in the "Very Poor" condition. All of the sites within the upland meadow community were in this condition class(Table 3-7-56).

Soils on 21,825 acres, or 61.9% of the study area, were in a downward or deteriorating trend (Table 3-7-57). Almost a third (29.5%) of the area - 10,421 acres - was placed in a stable or no apparent trend category. A small minority of the study area, 8.6% or 3,022 acres, was in improving or upward trend. The most markedly deteriorating soils were found in the pinyon-juniper vegetation type, followed by those in the sagebrush and then the upland meadow. associations (Table 3-7-57).

c. Browse Condition and Trend - Browse condition studies consider only three possible condition classes - good, fair, and poor. Browse condition was determined to be almost entirely (98.4%) within the "Good" condition class (Table 3-7-58). The area encompassed by this category comprised 34,219 acres. A collective area of sites totalling 482 acres, 1.4% of the area, was placed in the "Fair" condition class. Only 73 acres, 0.20% of the area, was judged to be in "Poor" condition(Table 3-7-58).

TABLE 3-7-55 . RESULTS OF SOIL CONDITION AND TREND CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Condition	Trend	Acreage	% of Total
	Pinyon-Juniper		
Fair	down	27	0.01
Poor	stable	134	0.4
Poor	down	13648	38.7
Very Poor	down	122	0.3
		13930	
	Sagebrush		
Good	up	683	1.9
Fair	up	298	0.8
Fair	stable	395	1.1
Fair	down	1487	4.2
Poor	up	1730	4.9
Poor	stable	1105	3.1
Poor	down	5763	16.3
Very Poor	stable	42	0.1
Very Poor	down	350	1.0
		11853	
	Mixed Brush		
Fair	stable	369	1.0
Poor	stable	8130	23.1
		8499	
	Upland Meadow		
Very Poor	stable	100	0.3
Very Poor	down	396	1.1
		496	
	Aspen		
Excellent	up	133	0.4
Good	up	54	0.2
Fair	up	62	0.2
Poor	up	64	0.2
		313	
	Douglas-Fir		
Good	stable	10	0.0
Fair	stable	73	0.2
Fair	down	33	0.1
		116	
	Greasewood		
Fair	stable	63	0.2
		63	

TABLE 3-7-56. SUMMARY OF SOIL CONDITION CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Condition	Acreage	% of Total
	Pinyon-Juniper	
Excellent	0.0	--
Good	0.0	--
Fair	27.0	0.1
Poor	13782.0	39.0
Very Poor	122.0	0.3
	Sagebrush	
Excellent	0.0	--
Good	683.0	1.9
Fair	2179.0	6.2
Poor	8598.0	24.4
Very Poor	392.0	1.1
	Mixed Brush	
Excellent	0.0	--
Good	0.0	--
Fair	369.0	1.0
Poor	8130.0	23.1
Very Poor	0.0	--
	Upland Meadow	
Excellent	0.0	--
Good	0.0	--
Fair	0.0	--
Poor	0.0	--
Very Poor	496.0	1.4
	Aspen	
Excellent	133.0	0.4
Good	54.0	0.2
Fair	62.0	0.2
Poor	64.0	0.2
Very Poor	0.0	--
	Douglas-Fir	
Excellent	0.0	--
Good	10.0	0.0
Fair	105.0	0.3
Poor	0.0	--
Very Poor	0.0	--

Table 3-7-56. (Continued)

Condition	Acreage	% of Total
	Greasewood	
Excellent	0.0	--
Good	0.0	--
Fair	63.0	0.2
Poor	0.0	--
Very Poor	0.0	--
	Total Area	
Excellent	133.0	0.4
Good	746.0	2.1
Fair	2806.0	7.9
Poor	30574.0	86.7
Very Poor	1010.0	2.9

TABLE 3-7-57. SUMMARY OF SOIL TREND CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Trend	Acreage	% of Total
	Pinyon-Juniper	
Up	0.0	--
Stable	134.0	1.0
Down	13797.0	99.0
	Sagebrush	
Up	2710.0	7.7
Stable	1543.0	4.4
Down	7600.0	21.5
	Mixed Brush	
Up	0.0	--
Stable	8499.0	24.1
Down	0.0	--
	Upland Meadow	
Up	0.0	--
Stable	100.0	0.3
Down	396.0	1.1
	Aspen	
Up	313.0	0.9
Stable	0.0	--
Down	0.0	--
	Douglas-Fir	
Up	0.0	--
Stable	82.0	0.2
Down	33.0	0.1
	Greasewood	
Up	0.0	--
Stable	63.0	0.2
Down	0.0	--
	Total Area	
Up	3023.0	8.6
Stable	10421.0	29.5
Down	21825.0	61.9

TABLE 3-7-58. SUMMARY BROWSE CONDITION
CONDUCTED ON AND NEAR TRACT C-a IN
RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Condition	Acreage	% of Total
	Pinyon-Juniper	
Good	13931	40.1
	Sagebrush	
Good	11399	32.8
Fair	454	1.3
	Mixed Brush	
Good	8499	24.4
	Aspen	
Good	313	0.9
	Douglas-Fir	
Good	15	0.0
Fair	27	0,1
Poor	73	0.2
	Greasewood	
Good	63	0.2
	Total Area	
Good	34219	98.4
Fair	482	1.4
Poor	73	0.2

Even though most of the browse was in good condition, the largest portion, 59.7% or 20,756 acres, exhibited a deteriorating or downward trend (Tables 3-7-59 and 3-7-60). An area about one-half that size, 10,435 acres or 30.0% of the acreage, showed no apparent trend.

4. Discussion - Range condition classes can be described conceptually as stages of plant community succession or retrogression, resulting from physical, edaphic, and biotic interactions. The latter category includes the grazing impacts of domestic livestock, feral horses, big game, and smaller herbivores and is the most amenable to manipulation by man.

Range condition and trend studies show no evidence of intensive, short term overuse by ungulates in the study area. In addition, definitive interpretation on one year of baseline data is impossible. Climatological and other biotic factors vary from year to year, thereby influencing community structure. As more data is collected and analyzed, better interpretation can be made in defining existing range conditions in the Tract C-a study area. Three-fourths of the area was found to be in "Fair" condition (Table 3-7-52), almost one-fourth in "Poor" condition, and a small percentage in "Good" condition. A slightly greater proportion (48.5%) of the area exhibited an upward trend or improving condition compared to that showing a downward trend (43.4%). The remaining sites showed no apparent trend. These comparisons indicate a state of relative equilibrium and no conclusive tendencies.

Soils, however, were found to be in a relatively depleted condition, with 86.7% of the area soils in "Poor" condition. Moreover, 61.9% of the area was in a downward trend versus 8.6% in an upward trend, with the remainder showing no apparent trend. The studies indicate that although rangelands may have generally stabilized, soil conditions are deteriorating.

An analytical evaluation of the data assembled during the range studies suggests that one of two processes may be occurring on the study area. Both processes are propounded here as hypotheses for the consideration of the reviewer, and

TABLE 3-7-59. BROWSE CONDITION AND TREND CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Condition	Trend	Acreage	% of Total
	Pinyon-Juniper		
Good	up	731	2.1
Good	stable	1254	3.6
Good	down	11945	34.4
	Sagebrush		
Good	up	1851	5.3
Good	stable	1051	3.0
Good	down	8496	24.4
Fair	up	203	0.6
Fair	down	251	0.7
	Mixed Brush		
Good	up	369	1.1
Good	stable	8130	23.4
	Upland Meadow		
Not applicable			
	Aspen		
Good	up	313	0.9
	Douglas-Fir		
Good	up	15	0.0
Fair	up	27	0.1
Poor	up	73	0.2
	Greasewood		
Good	down	63	0.2

TABLE 3-7-60. SUMMARY BROWSE TREND CONDUCTED ON AND NEAR TRACT C-a IN RIO BLANCO COUNTY, COLORADO FOR RBOSP DURING SUMMER, 1975

Type	Acreage	% of Total
	Pinyon-Juniper	
Up	731	2.1
Stable	1254	3.6
Down	11945	34.4
	Sagebrush	
Up	2054	5.9
Stable	1051	3.0
Down	8748	25.2
	Mixed Brush	
Up	369	1.1
Stable	8130	23.4
	Aspen	
Up	313	0.9
	Douglas-Fir	
Up	115	0.3
	Greasewood	
Down	63	0.2
	Total Area	
Up	3582	10.3
Stable	10435	30.0
Down	20756	59.7

arguments in support of each are explored and explicated. Long term studies would be necessary to establish the absolute validity of either theory.

One possibility is that a differential exists between the range and soil recovery curves, or a "time lag" delays the response of soil conditions. If a recovery has occurred on most ranges within the study area, condition has stabilized; i.e., consumption by herbivores is not adversely affecting community composition, plant density, or plant vigor. Conversely, soil conditions are generally lower and continuing to decline. It should perhaps be explained that changes in condition and trend are not immediate responses to release from disturbances. There is a "momentum effect" -- that is, alleviation of the stress factor may require a number of years for a measurable response. If this is the case, there has not yet been a distinct tendency for stabilization or improvement of soil conditions. There are a multitude of factors or interactions of factors which may be affecting the recovery differential. A most logical explanation might simply be that soil responses to improved conditions require a longer time to manifest themselves than do vegetation responses. A climatic shift or a change in precipitation patterns or intensities could influence soil conditions and trends. Even though many of the forage plants present are desirable, their low density and inability to form a closed canopy expose large proportions of bare soils to the elements. Features inherent in the soils themselves, such as their high erodability, may make soil movement (hence the condition) a natural phenomenon of the regional geology.

There is evidence to support the first theory. In 1971, the Cathedral Bluffs Grazing Unit was divided into individual grazing allotments. Management plans to ensure more efficient utilization of forage and a more balanced allocation of that resource were implemented by the BLM on the Square S and Reagle Allotments four years ago (personal communication, November, 1975, Stan Colby, Bill Lawthorne, Meeker, BLM office). Ranchers interviewed in the area believe that local ranges have been improving gradually for the past several years and looked better this past season than at any time in recent years (personal communications,

July, 1975). Mule deer, which utilize the area for winter and transitional ranges, have decreased drastically since the 1950's (personal communication, 1975, Colorado Division of Wildlife). Given these circumstances, a recovery in range condition could be reasonable expected.

A second hypothesis would perceive the range condition and trend studies inconclusive. Range condition is only one of several indicators of the health and well-being of a grazing ecosystem. Although the applied methodology revealed local ranges to be in generally moderate condition, these ratings were heavily influenced by the relatively high numbers of desirable forage species. The other factors considered in determining condition (cover and vigor) were generally low. Widespread retrogradation of soils in the study area and low forage production (see Production-Utilization Section) are other indicators.

Browse conditions on the study area were overwhelmingly in the "Good" condition class. A large portion, however, was seen to exhibit downward trend, or a deterioration in condition based on one year of baseline data. Mule deer use the area primarily as transitional range except in mild winters (see Aerial Big Game Censuses Section), a fact which is reflected in the favorable condition which prevails. The evidence that browse conditions are deteriorating may correspond to increases in feral horse numbers. These animals use the area year-round and utilize the browse species heavily when snow depths retard access to preferred herbaceous species.

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Figures and Tables for the

Range Analysis Section

File No.____________

Sheet_____ of______

RANGE AND BROWSE CONDITION-PACED TRANSECT

Transect No.______________ Vegetation Type______________

Location: T________ R________ S________ 1/4 1/4 S________ Date__________

Slope__________ Aspect__________ Elevation__________

Field Analyst(s)______________________ Pace Interval__________

QA Check__________

CONDITION AND TREND RATING

Vegetation

Vigor__________

Current Trend__________

Soil Stability

Current Erosion__________

Current Trend__________

COMPOSITION

Classification	Species	Hits	Tally	Total
	Litter			
	Rock			
	Bare Ground			

BROWSE CONDITION

Species	Age Class: Young	Mature	Decadent	Dead	Form Class: 1	2	3	4	5	6	Unavailable

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ecology consultants, inc.

Figure 3-7-19. Data sheet for range and browse condition-paced transect for RBOSP.

Table 3-7-42. Criteria for rating vigor for key grass species observed on range analysis paced transects for RBOSP

1. Tall Grasses

   a. Leafy with long (8 inches or longer) leaves, and numerous seed stalks per plant (50 or more for sideoats) 9-10

   b. Plants less leafy and with fewer seed stalks (10 to 50 for sideoats) leaves 6 inches or longer 5-8

   c. Leaves 4 to 6 inches, few seed stalks (3 to 10 for sideoats)....... 2-4

   d. Plants weak, partly dead, or pull up easily; leaves short (4 inches or less) and seed stalks absent or 1 per plant 0-1

2. Mid Grasses

   a. Leafy with long (7 inches or longer) leaves and produce abundant seed; blue grama will have many seed stalks with three or more spikes 9-10

   b. Plants less leafy, leaves 5 inches or longer; the majority of blue grama seed stalks will have 2 spikes 5-8

   c. Plants with fewer leaves; blue grama seed stalks usually will have one and not more than 2 spikes 2-4

   d. Plants weak, pull up easily, leaves short (3 inches or less), seed stalks few or none; blue grama seed stalks will have only a single spike 1 inch or less in length 0-1

Table 3-7-43. Criteria for rating current soil erosion on range analysis paced transects for RBOSP

a. Plant cover and litter. Well distributed; effective in protecting the soil .... (50-41)

(1) Bare Spaces. Small and well dispersed; not contiguous or coalescing.

(2) Erosion Pavement. Not present.

(3) Soil Movement. Practically none; no active rills or gullies; areas eroded in the past, if evident, completely stabilized and healed.

(4) Soil Deposition. If present, not of local origin.

(5) Pedestaling. Not present

(6) Trampling. No current trampling displacement evident; old terraces due to trampling, if present are completely stabilized.

b. Plant Cover and Litter. Well distributed; appears effective in protecting the soil, litter dams uncommon .... (40-31)

(1) Bare Spaces. Small, well dispersed, occasionally coalescing.

(2) Erosion Pavement. Little or none.

(3) Soil Movement. Slight and patchy, no gullies; rills, if present, few and isolated. Areas eroded in the past, if evident, mostly stabilized and healed.

(4) Soil Deposition. Slight, mostly not of local origin.

(5) Pedestaling. Little, close to bare spaces.

(6) Trampling. Little current trampling displacement; stabilized.

c. Plant Cover and Litter. Thin or discontinuous and not well distributed; litter dams evident .... (30-21)

(1) Bare Spaces. Often coalescing but with no continuous runoff pattern, large spaces less common than small ones.

(2) Soil Movement. Discernible on less than half of the area; may be accelerated in spots and stable elsewhere; occasional rills; few active gullies, may be evidence of wind scouring.

(3) Soil Deposition. Occasional small alluvial deposits present; wind deposits may be evident as small dunes.

(4) Pedestaling. Common

(5) Trampling. Current trampling displacement may be common either in form of trailing or general displacement.

d. Plant Cover and Litter. Sparse, patchy, and definitely not effective in preventing soil movement; litter dams may or may not be present..(20-11)

(1) Bare Spaces. Frequent, commonly coalesced with a definite runoff pattern; large bare spaces common, subsoils may be evident in small areas.

(2) Erosion Pavement. Well developed in most bare spaces.

(3) Soil Movement. Prominent; active rills and gullies common; small blowouts common in windy areas.

(4) Soil Deposition. Conspicuous alluvial deposits common; wind deposits may be prominent in small dunes; plant root crowns and stems partly buried.

(5) Pedestaling. Majority of plants pedestaled.

(6) Trampling. Current trampling displacement widespread and generally distributed.

e. Plant Cover and Litter. Plants and litter isolated with very limited effect on control of soil movement .... (10-0)

(1) Bare Spaces. Generally large with prominent runoff pattern; subsoils exposed generally over the area.

(2) Erosion Pavement. Continuous on stony or gravelly soils.

(3) Soil Movement. Severe with extensive rilling and gullying, in windy areas, blowouts are large and common.

(4) Soil Deposition. Large dunes common on light soils; plant root crowns and stems deeply buried, drainage channels choked with alluvial deposits.

(5) Pedestaling. Nearly all plants pedestaled.

(6) Trampling. Current trampling displacement widespread and excessive.

Table 3-7-44. Criteria for determining vegetation and soil trends on range analysis paced transects for RBOSP

a. Indicators of Upward Vegetation Trend

(1) Desirable and intermediate forage plants becoming more abundant.

(2) Desirable and intermediate forage plants invading bare ground or stands of undesirable plants. A variety of all age classes of better forage plants must be present.

(3) Establishment of perennial plants on erosion pavement.

(4) Several years of vigorous growth on browse.

(5) Decreaser plants increasing and vigorous. Grasses with long, green leaves, and numerous healthy seed stalks.

(6) A well dispersed accumulation of litter.

b. Indicators of Downward Vegetation Trend

(1) Desirable and intermediate species decreasing in vigor.

(2) Lack of young plants from desirable and intermediate species.

(3) Invasion by undesirable species.

(4) Hedged and highlined shrubs. Dead branches generally indicating that shrubs are dying back.

(5) Litter scarce and poorly dispersed.

c. Indicators of Upward Soil Trend

(1) Gullies approaching the angle of repose and healing.

(2) Gullies stabilizing by the growth of perennial vegetation on both sides and bottom.

(3) Soil remnants having sloping sides or sides covered with mosses, lichens, or higher plants.

(4) Terraces characterized by sloping sides which are being covered with vegetation. Tops of terraces should be occupied by perennial plants.

d. Indicators of Downward Soil Trend

(1) Rill marks. Rill marks are small, active gullies frequently of the shoestring type.

(2) Active gullies. Established gullies are raw and actively cutting. This type of gully may vary from a few inches to several feet in depth.

(3) Alluvial deposits. Soil material transported and laid down by running water.

(4) Soil remnants. Original topsoil held in place by vegetation or plant roots.

(5) Active terraces. Terraces usually caused by hooves of animals. They are "stairstep like" in appearance on slopes.

(6) Exposed plant crowns or roots (pedestalled plants).

(7) Wind-scoured depressions between plants.

(8) Wind deposits.

Table 3-7-45. Criteria for determining age and form class of browse species on range analysis paced transects for RBOSP

BROWSE AGE AND FORM CLASS

<u>Age Class</u>

S - Seedling
Y - Young plant
M - Mature plant
D - Decadent plant

<u>Form Class</u>

1. All available, lightly hedged
2. All available, moderately hedged
3. All available, heavily hedged
4. Largely available, lightly hedged
5. Largely available, moderately hedged
6. Largely available, heavily hedged
7. Mostly unavailable
8. Unavailable

<u>Seedling</u>: Plant up to three years old which has become firmly established, usually less than 1/8-inch diameter.

<u>Young plant</u>: Larger, with more complex branching and more fibrous bark than seedling, does not show signs of maturity. Usually between 1/8- and 1/4-inch diameter.

<u>Mature plant</u>: Complex branching, rounded growth form, larger size. Seed is produced on healthy plants. Generally larger than 1/4-inch diameter.

<u>Decadent</u>: Plant regardless of age that is in a state of decline, usually evidenced by 25 percent or more dead branches.

<u>Lightly hedged</u>: 0-40 percent of twigs browsed.

<u>Moderately hedged</u>: 41 to 60 percent of twigs browsed.

<u>Heavily hedged</u>: 61% or more of twigs browsed.

Degree of hedging is based on leader use over the past three years; current annual growth is not included.

<u>All available</u>:

	3.5 feet
	4 feet
Mule deer, cattle	5 feet
Elk	7 feet

<u>Largely available</u>: One-third to two-thirds of plant available to animal.

<u>Mostly available</u>: Less than one-third of plant available.

In classifying browse for form class, unavailability may be the result of height, location, or density.

Table 3-7-46. Composition rate scale for range analysis data for RBOSP

Value	Rating	Value	Rating	Value	Rating
198 to 200 =	54	98 to 102 =	36	2 to - 2 =	18
192 to 197 =	53	92 to 97 =	35	-3 to - 8 =	17
186 to 191 =	52	87 to 91 =	34	-9 to - 13 =	16
181 to 185 =	51	81 to 86 =	33	-14 to - 19 =	15
175 to 180 =	50	75 to 80 =	32	-20 to - 25 =	14
170 to 174 =	49	70 to 74 =	31	-26 to - 30 =	13
164 to 169 =	48	64 to 69 =	30	-31 to - 36 =	12
159 to 163 =	47	59 to 63 =	29	-37 to - 41 =	11
153 to 158 =	46	53 to 58 =	28	-42 to - 47 =	10
148 to 152 =	45	48 to 52 =	27	-48 to - 52 =	9
142 to 147 =	44	42 to 47 =	26	-53 to - 58 =	8
137 to 141 =	43	37 to 41 =	25	-59 to - 63 =	7
131 to 136 =	42	31 to 36 =	24	-64 to - 69 =	6
125 to 130 =	41	25 to 30 =	23	-70 to - 74 =	5
120 to 124 =	40	20 to 24 =	22	-75 to - 80 =	4
114 to 119 =	39	14 to 19 =	21	-81 to = 86 =	3
109 to 113 =	38	9 to 13 =	20	=87 to - 91 =	2
103 to 108 =	37	3 to 8 =	19	-92 to - 97 =	1
				-98 to -100 =	0

Table 3-7-47. Criteria for determining vegetation cover score for data collected on range analysis paced transects for RBOSP

Pinyon-juniper grasslands

Hits	Score	Hits	Score	Hits	Score
60 plus	= 26	43	= 30	21	= 14
59	= 27	42	= 29	19 & 20	= 13
58	= 28	41	= 28	13	= 12
57	= 29	40	= 27	16 & 17	= 11
56	= 30	39	= 26	15	= 10
55	= 31	37 & 38	= 25	13 & 14	= 9
54	= 32	36	= 24	12	= 8
53	= 33	34 & 35	= 23	10 & 11	= 7
52	= 34	33	= 22	9	= 6
51	= 35	31 & 32	= 21	7 & 8	= 5
49 & 50	= 36	30	= 20	6	= 4
48	= 34	28 & 29	= 19	4 & 5	= 3
47	= 34	27	= 18	3	= 2
46	= 33	25 & 26	= 17	1 & 2	= 1
45	= 32	24	= 16	0	= 0
		22 & 23	= 15		

Table 3-7-48. Criteria for rating erosion hazard from range analysis data for RBOSP

Erosion Hazard (Percent surface exposed to erosion)	Rating Scale (0-50)
0- 7	50-41
8- 15	40-31
16- 30	30-21
31- 60	20-11
61-100	10- 0

Table 3-7-49. Criteria for rating browse condition and trend for range analysis data for RBOSP

A. Rating browse condition

	Form Classes (Degree of Hedging)			
	Light 1 & 4	Moderate 2 & 5	Heavy 3 & 6	Numerical rating
Good	50	0-50	0-25	15
Fair	0-50	50	0-50	10
Poor	0-25	0-50	50	5

B. Rating browse trend

	Numerical rating
Up: Young plants more than decadent	15
Stable: Young plants equal to decadent	10
Down: Young plants less than decadent	5

Table 3-7-50. Designation of condition classes for vegetation and soil data collected in each range analysis transect for RBOSP

Range condition (Composition and cover and vigor)		Browse Condition (form classes)		Soil Condition Erosion Hazard and current erosion	
Rating	Condition Class	Rating	Condition Class	Rating	Condition Class
81-100	Excellent	15	Good	81-100	Excellent
61-80	Good	10	Fair	61-80	Good
41-60	Fair	5	Poor	41-60	Fair
21-40	Poor			21-40	Poor
0-20	Very poor			0-20	Very poor

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Table 3-E-30. Designation of condition classes for vegetation and soil data collected in each range analysis transect for [illegible]

Range Condition (Composition and cover and vigor)		Browse Condition (Form classes)		Soil Condition (Erosion hazard and current erosion)	
Rating	Condition Class	Rating	Condition Class	Rating	Condition Class
81-100	Excellent	15	Good	81-100	Excellent
61-80	Good	10	Fair	61-80	Good
41-60	Fair	5	Poor	41-60	Fair
21-40	Poor			21-40	Poor
0-20	Very poor			0-20	Very poor

D. Range Production-Utilization

1. Objectives - Forage production and utilization studies were undertaken to measure the actual forage being produced annually per unit area within each major association. The amount of forage taken by large herbivores at a given point in time is also measured. These studies will reveal the relative preferences of herbivores for particular plant associations.

2. Methods

a. Data Collection - Grass and forb production utilization studies were conducted within four principal plant associations: pinyon-juniper, sagebrush, mixed brush and grass balds. Annual forage production figures were obtained by late summer clippings of .89 m^2 (9.6 sq ft) plots which have been protected through the growing season by conical 5 cm x 10 cm (1.95 in. 3.9 in) mesh welded wire cages. Sixty-six cages were distributed throughout the study area. The locations of these cages corresponded to the locations of certain previously established vegetation transects for phytosociological studies. Numerical distribution of cages approximated the natural proportionate distribution of vegetation types within the study area. These sites were selected to encompass physical parameters such as slope, aspect, and elevational variations occurring within a vegetation type. The cages were distributed as follows: pinyon-juniper sites - 21, sagebrush sites - 26, mixed brush sites - 13, and grass balds - 10. Grass balds do not constitute a major area within the region of study but are important from a forage production standpoint. In the first three vegetation types, two cages were situated in the locality of each non-permanent vegetation transect of the May, 1975 phytosociological studies. In the grass bald sites, two cages were located

at each vegetation transect regardless of its permanence status from the May 1975 vegetation sampling period. Shadscale, rabbitbrush, greasewood, Douglas-fir, aspen, and riparian sites were not sampled due to the relatively minor contribution these vegetation types make to total productivity in the study area. Cages were located 3-5 m (10 to 17 ft) to the right of the 20 m (66 ft) and 100 m (330 ft) mark on each non-permanent transect. Cages are 1.64 m (5.38 ft) tall and 1.65 m (5.41 ft) in diameter and are anchored with rebar stakes.

After completion of the growing season in late August or early September, forage utilization was measured by comparing clippings from plots which were protected from grazing with clippings from plots which were unprotected. A grazed (unprotected) plot was located near each caged plot by using the second hand of the observer's watch to determine direction, and a random numbers table to determine distance in paces. The unprotected plot was clipped and weighed; all samples were marked with the location and date of collection.

Ocular estimates of forage production were made concurrently to supplement the above method. Observers underwent a training period during which they ocularly estimated, then clipped and weighed for comparison, enough plots to ensure consistency of estimation. For each cage sample, ten ocular estimate plots were sampled, one of which (the unprotected plot described above) was clipped and weighed to provide a correction factor for and a check of the observer's accuracy of estimation. Estimates and clipped weights were recorded on a standard data form (Figure 3-7-22).

All clipped samples were returned to the ECI laboratory, oven-dried at 70°C for at least 24 hours in a Thelco oven, and weighed again to provide dry weight estimates.

b) Data Analysis - All ocular estimates were corrected to dry weights and also corrected for errors of ocular estimation by the following formula:

$$\text{ocular estimate} \times ((1-(\bar{x}_1/\bar{y}_1))+1) \times ((1-(\bar{y}_1/\bar{y}_2))+1)$$

Where: $\bar{x}_1$ = mean of ocular estimates
$\bar{y}_1$ = mean of clipped weights
$\bar{y}_2$ = mean of dried weights

For each vegetation type sampled, the following parameters were estimated:

- Dry weight production (lbs/A and Kg/ha)
  lbs/A = corrected cage plot mean x 10
  kg/ha = corrected cage plot mean x 11.3
- Percent utilization:

$$\frac{\text{(corrected cage plot mean - corrected ocular estimate mean)}}{\text{(corrected cage plot mean)}} \times 100$$

- Utilized forage production (lbs/A and kg/ha)
  lbs/A = (corrected cage plot mean-corrected ocular estimates mean) x 10
  kg/ha = (corrected cage weight mean - corrected ocular estimates mean) x 11.3

3. Data Summary - Production varied widely over the study area from a mean of 92.86 pounds/acre (104.93 kilograms/hectare) on pinyon-juniper sites to 240.00 pounds/acre (271.20 kilograms/hectare) on mixed brush sites. Sites located in the sagebrush vegetation type produced an average 185.50 pounds/acre (209.62 kilograms/hectare) and upland meadow sites produced 173.00 pounds/acre (195.49 kilograms/hectare) (Table 3-7-61).

These figures compare unfavoranly with Soil Conservation Service (United States Department of Agriculture, 1975) estimates of range site production potentials for northwestern Colorado as follows. The "Stoney Foothills Range Site", which corresponds to most area pinyon-juniper vegetation types, is capable of producing 400-800 pounds of air-dry forage per acre. The "Mountain Loam and Loamy Slopes Range Sites", which encompass the mixed brush vegetation types, have been given production of

1200-1800 and 500-1200 pounds/acre, respectively. The "Clayey Foothills Range Site", corresponding to many study area sagebrush vegetation type sites, has a production potential of 600-1200 pounds/acre. The SCS "Dry Exclosure Range Site" corresponds to the upland meadow vegetation type and has a production potential of 500-650 pounds/acre.

Utilization studies were undertaken concurrently with productivity studies. Such studies would normally be conducted at the conclusion of the grazing season but there is year-round grazing within the study area. Cattle use the area until they are excluded by a permanent snowpack. Feral horses remain there all year, pawing through snow to obtain the remaining forage. The end of the growing season, approximately the beginning of September, was selected as the sampling period since the time was optimum for productivity clipping. Because of aforementioned conditions, there is no optimum time for obtaining utilization measurements. Those that follow should be interpreted as relative indices of herbivore utilization on the various vegetation types through completion of the growing season, not as total annual utilization.

4. Discussion - Utilization ranged from 7% on sagebrush sites to 43% on upland meadow sites. Mixed brush sites had 41% of total forage production utilized and pinyon-juniper sites received 24% utilization (Table 3-7-61).

Forage production was well below minimal SCS expectations (United States Department of Agriculture, 1975) for range sites included in the study area during unfavorable years. Precipitation was subnormal this past year (personal communication, November, 1975, G. Cresswell, EG&G - information obtained from compilation of weather records from Rifle, Meeker, and Rangely, Colorado), but not sufficiently subnormal to account for the low production. Pinyon-juniper sites were the lowest producing ranges, while mixed brush vegetation type produced the highest amount of forage.

Productivity is highly correlated with the increased precipitation occurring at higher elevations. The upland meadow sites, however, are swept clean of winter snow accumulations by high velocity winds and so do not receive the benefit of precipitation

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occurring as snow. Aerial surveys have revealed that these areas are utilized heavily in the winter by feral horses. The mixed brush vegetation type exhibited the greatest productivity because of deeper soils (with the excpetion of bottomland sage stands on alluvial deposits) and the most favorable moisture conditions. The pinyon-juniper sites were the least productive due to the shallow soils, lesser annual precipitation, and completion for soil moisture between forage and canopy species. The fact that feral horses and mule deer concentrate in these sites during winter months to seek respite from chilling winds and temperatures contributes to the conditions which prevail there. The sagebrush vegetation type was the most variable since no distinction was made between upland and bottomland sites. Bottomland sites on deep alluvial deposits were basin wildrye (Elymus cinereus) was dominant were highly productive, whereas some upland sites were almost void of a grass-forb understory. These differences were attributed to variations in soil depth, and soil moisture competition.

By early September, utilization was directly related to elevational zonations. Heaviest use occurred on the upland meadow sites (the bald areas atop the highest ridges in the study area). The next heaviest use was found in the mixed brush vegetation type, which occurs primarily in the next lower elevational zone. Intermediate use was seen in the pinyon-juniper vegetation type. Lowest utilization was found on the lower occurring sagebrush vegetation types.

Literature Cited

United States Department of Agriculture, Soil Conservation Service. 1975. Rangeland plant communities in the central desertic basins, mountains and plateaus. Land resource area (MLRAD-34), in Colorado. Technical Guide, Section 11 E.

Figures and Tables for the

Range Production - Utilization Section

File No.________________

FORAGE PRODUCTION AND UTILIZATION

Project__________ Location: T_____ R_____ S_____ 1/4 1/4 S_____ Date______________

Field Analyst(s)______________ Lab Analyst______________ QA Check_____ Date________

General Site Description____

Conditions Possibly Affecting Data____________________________________

OCCULAR ESTIMATION

20 m		100 m	
Plot		Plot	
1	________	1a	________
2	________	2a	________
3	________	3a	________
4	________	4a	________
5	________	5a	________
6	________	6a	________
7	________	7a	________
8	________	8a	________
9	________	9a	________
10	________	10a	________
Cage 1	________	Cage 2	________

Plot 1 field weight____________ Plot 1a field weight____________

Plot 1 dry weight____________ Plot 1a dry weight____________

Cage 1 field weight____________ Cage 2 field weight____________

Cage 1 dry weight____________ Cage 2 dry weight____________

Figure 3-7-22 Forage production and utilization data sheet for RBOSP

Table 3-7-61. Production utilization studies conducted on and near Tract C-a in Rio Blanco County, Colorado for RBOSP during the fall of 1975

Vegetation Site	Dry Weight Production (lbs./A)	Dry Weight Production kg/ha)	Percent Utilization	Utilized Forage Production (lbs./A)	Utilized Forage Production (kg/ha)
Pinyon-juniper	92.9	104.9	24.1	16.0	18.0
Sagebrush	185.5	209.6	6.9	9.9	11.1
Mixed Brush	240.0	271.2	40.7	74.9	84.6
Grass Bald	173.0	195.5	42.7	50.2	56.7

E. Browse Condition and Utilization

1. Objectives - Certain areas of the Piceance Basin are of primary importance as winter range for large numbers of mule deer. It is important to learn what the pre-development levels of browse condition and utilization are, to ascertain whether carrying-capacities of current game ranges are in balance with existing deer populations, and to monitor how utilization patterns and intensities change as development proceeds.

2. Methods

a. Data Collection - Browse condition and utilization studies are conducted on a minimum of 100 sampling locations (units). These locations were pre-determined by examination of phytosociological vegetation maps and selection of sites which support a preponderance of the key species of particular interest. The study program was adapted from National Park Service Methodologies (Cole, G.P., 1963, Range Survey Guide, United States Department of the Interior). At each location, 25 shrubs of key browse species are examined. Key species include: juniper (*Juniperus osteosperma*), pinyon (*Pinus edulis*), bitterbrush (*Purshia tridentata*), serviceberry (*Amelanchier* sp.), chokecherry (*Prunus virginiana*), and snowberry (*Symphoricarpos oreophilus*).

Sampling units are established by arbitrarily selecting a shrub and marking it with two steel rebar stakes, three and six feet distant from the base of the shrub. The more distant stake is marked with fluorescent orange paint. Subsequent shrubs are located along a transect (sampling unit) by selecting the closest shrub within a 180° arc of the center of the examined shrub. When two or more shrubs are equally distant, the one closest to the starting point of the arc is selected.

During sampling, five parameters are examined and recorded (Figure 3-7-23): (1) form class, (2) age class, (3) leader use estimates, (4) hedging classification, and (5) availability. Each is determined as follows:

- Form Classes:
  1. All available, little or no hedging
  2. All available, moderately hedged
  3. All available, severely hedged
  4. Partially available; little or no hedging
  5. Partially available; moderately hedged
  6. Partially available; severely hedged
  7. Unavailable
  8. Dead
- Age Classes
  S - seedling - less than 1/8 inch basal diameter
  Y - young - 1/8 to 1/4 inch basal diameter
  M - Mature - over 1/4 inch basal diameter
  D - Decadent - more than 25% of crown surface is dead
- Leader Use Estimates are based on the percent of twigs or leaders which are available and show use:

Recorded Values	Percentage Ranges
0	
5	1 - 9
25	10 - 39
50	40 - 59
75	60 - 89
95	90 - 100

- Hedging Classification is based upon the length and appearance (hedging) of the previous year's growth (the two year-old wood).
  1. None to light
  2. Moderate
  3. Severe
- Availability is a visual estimation of the percent of the plant available to deer as browse, i.e., that proportion less than six feet high.

h. Data Analysis - Hedging classification is used to assign a condition rating to each sample unit.

Percent of Severely Hedged or Decadent Plants	Condition Rating
0 - 10	Excellent
11 - 20	Good
21 - 30	Fair
31 - 50	Poor
50 plus	Very poor

Availability is expressed as a mean percentage, form and age class data as percentages of shrubs comprising each class, and leader use estimates as averages. These calculations are applied to species within a sample unit, the whole sample unit, species within the entire study area, and the study area itself.

3. Data Summary - No data were collected for this program during the reporting year 1974-1975.

Literature Cited

Cole, G. P. 1963. Range survey guide. United States Department of the Interior. National Park Service. Washington, District of Columbia. 9 pages.

BROWSE CONDITION AND UTILIZATION DATA SHEET

Vegetation Type:______________________________ Sample Unit #:________

T______ R______ S______ 1/4 1/4 S__________ Date:______________

Aspect (degrees)__________ Slope (degrees)__________ Elevation (feet)__________

Field Analyst(s):______________________________ QA Check:______________

No.	Species	Form Class	Age Class	Leader Use	Hedging Class	Availability
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

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ECI *ecology consultants, inc.*

Figure 3-7-23 Browse condition and utilization data sheet for RBOSP

7.2. FAUNA

A. Small Mammals

1. Objectives - The small mammal census program is designed to identify the species of small mammals that occur within Tract C-a and the contiguous area, to determine their densities in dominant habitats, and to aid in developing a designation of important species. Seasonal periodicity of activity, reproductive effort and trophic relationships are to be described. Small mammal habitat affinity will be determined asnd species diversity values will be calculated for the various habitats.

2. Methods

a. Data Collection

1) Live Trapping - A live trapping program, consisting of trapping periods during the 2-year baseline inventory, was initiated during October, 1974. To coincide with periods of increased small mammal activity and to provide adequate data on reproduction and other population parameters, sampling was conducted during October, 1974, May, July, and September, 1975 and will occur during May, July, and September, 1976. Trapping periods during December, 1974 and 1975 will provide information on small mammal winter activity patterns.

Within and adjacent to Tract C-a, five 7.29 ha (18A) grids were established to sample small mammal activity within the major vegetation associations (i.e., pinyon-juniper on north and south facing slopes, sagebrush, greasewood-sagebrush and mixed brush). Each grid has dimensions of 270 m x 270 m and consists of 133 stations, permanently marked with numbered stakes and flagging. The center of each grid consists of 49 stations, in a 7 x 7 pattern, spaced at intervals of 15 m. The remaining 84 stations, forming the boundaries of the grid, are spaced 30 m apart (Figure 3-7-24). This grid size and pattern is designed to aid in estimating population densities and home ranges for both the smaller rodents (mice and voles) and the larger, wider ranging chipmunks and most ground squirrels.

Seven 0.81 ha (2 A) grids and two, 1.35 ha (3.3 A) grids are also used in the trapping program. These grids are designed to determine the variation in small mammal population, in major vegetation types not represented on the tract (such as Douglas-fir), in edge habitats (habitats created by the juxtaposition of distinctly different vegetation types).

The 0.81 ha grids consist of 33 permanently marked stations in the same configuration as three lines of stations through the center of the larger grid (Figure 3-7-25). As the Aspen and Douglas-fir communities contain species of voles not generally found in other vegetation types in the area, four rows of seven stations each (for a total of 61 traps) are added to the central portion of the 0.81 ha grids established in these communities (Figure 3-7-26). The resulting 1.35 ha grids will provide more accurate population density and home range estimations for the voles. The types of vegetation sampled by the different grids are listed in Table 3-7-62 and grid locations are shown in Figure 3-7-27.

At each station of all the grids a 3" x 3" x 10" Sherman live trap is set during the spirng, summer, and fall sampling periods. Since small mammal activity is greatly curtailed during the winter season, and because repeated captures of the same individuals during cold weather will produce a high number of trap deaths, an extensive trapping program during December 1974 and 1975 could reduce population numbers andpreclude objective interpretation of results. Consequently, during these periods only 33 stations of the 7.29 and 1.35 ha grids in the same configuration as the 0.81 ha grids (Figure 3-7-25), and all stations of the 0.81 ha grids are operated.

Traps are baited with a mixture of peanut butter, rolled oats and cracked corn, and are checked for five consecutive days during each of the nine sampling periods. To minimize desiccation and death of trapped animals from the solar radiation, cardborad is positioned over each trap in a Λ shape to provide shade for animals captured during the day.

Seven, 0.81 ha (2 A) grids and two, 1.35 ha (3.3 A) grids are also used in the trapping program. These grids are designed to evaluate the range of small mammal population variation in major vegetation types not represented on the tract (such as Douglas fir), variation of small mammal populations in major vegetation types sampled by the 7.29 ha grid, and small mammals in edge habitats (habitats created by the juxtaposition of distinctly different vegetation types).

To provide a basis for comparison of population data from different sized grids, the 0.81 ha grids consist of 33 permanently marked stations in the same configuration as 3 lines of stations through the center of the larger grid (Figure 3-7-25). As the Aspen and Douglas fir communities contain species of voles not generally found in other vegetation types in the area, four rows of seven stations each are added to the center of the 0.81 ha grids established in these communities (Figure 3-7-26). The resulting 1.35 ha grids will provide more accurate population density and home range estimations for the voles. The types of vegetation sampled by the different grids are listed in Table 3-7-62 and grid locations are shown in Figure 3-7-27 .

At each station of all the grids a 3" x 3" x 10" Sherman live trap is set during the spring, summer, and fall sampling periods. Since small mammal activity is greatly curtailed during the winter season, and because repeated captures of the same individuals during cold weather will produce an unacceptably high number of trap deaths due to hypothermia, an extensive trapping program during December 1974 and 1975 could artificially reduce population numbers and preclude objective interpretation of results. Consequently, during these periods only 33 stations of the 7.29 and 1.35 ha grids, in the same configuration as the 0.81 ha grids (Figure 3-7-25), and all stations of the 0.81 ha grids are operated.

Traps are baited with a mixture of peanut butter, rolled oats and cracked corn, and are checked for five consecutive days during each of the 9 sampling periods. To minimize desiccation and death of trapped animals from the intense solar radiation characteristic of summers in the Piceance Basin, cardboard is positioned over each trap in a Λ shape to provide shade for animals captured

A wad of dacron, wool or cotton batting is placed at the back of each trap for bedding material, to minimize the number of deaths from hypothermia.

Traps are reset and rebaited as necessary. All animals captured are distinctively marked by unique toe-clipping combinations and released. For each animal captured, the species, sex, age class, weight, reproductive status, general physical condition (if other than normal), capture location and animal identification number are recorded on a standard trapping form (Figure 3-7-28). Weights are determined to 1.0 gm accuracy using a Pesola calibrated spring scale. Tail length is measured for distinguishing between Microtus longicaudus and M. montanus.

At certain times of the year trap success may be very high. When a large proportion of the traps on a grid catch animals during one night, some animals may not have an opportunity to enter trap stations located within their home range. This phenomenon, indicated by a high ratio of new animals to recaptures from previous nights, may yield inadequate population data for some species. In addition, high trap success with a low number of recaptures can interfere with home range estimation. To insure adequate data for all species, an increased trapping effort, using either more traps per night or more nights of trapping, is necessary. Increasing the number of traps on some grids but not on others would adversely affect the comparability of results from different grids. Therefore, based on the results of the fourth trap night, trapping effort will be extended for up to five additional days if the following decision criteria are met.

For 7.29 ha and 1.35 ha grids:

- (a) When overall trap success exceeds 50% for the pervious trap night, and (b) a minimum of three recaptures of at least five males of each predominant species for the site have not been recorded. Predominant species are those species whose relative abundance exceeds 30% for all captures at the site during the trapping period. Or,

When (a) overall trapp success exceeds 50% for the previous trap night, and (b) the ratio of unmarked to marked animals captured on the previous trap night exceeds 30% for the predominant species for the site.

For 0.81 ha grids:

- When (a) any large grids require extended trapping and, (b) overall trap success for the previous night on a 0.81 ha grid exceeds 50 percent and (c) the ratio of unmarked to marked animals captured the previous night exceeds 30% for the predominant species for the site. During extended trapping, data will be reanalyzed each evening until the criteria no longer require continued trapping. In no case will trapping be extended more than 5 days.

2) Collection of Animals for Laboratory Analysis - A removal trapping program designed to collect small mammals for laboratory analysis of reproductive effort or stomach contents occurs during each of the small mammal live trapping periods. Animals are being collected for analysis of stomach contents during October and December, 1974; during May, July, September and December, 1975, and during May and July, 1976. Animals are being collected for analysis of reproductive effort during months of peak small mammal breeding activity (May and July, 1975 and 1976). The removal program is conducted sufficiently far from the live trapping grids to prevent interference with the live trapping operations. Ideally, for each of the three most common small mammal species, up to five specimens (including at least two females) are collected by a line of 40 snap traps in the major vegetation types where that species occurs. Daily trapping effort is increased in those vegetation types where capture success is low. Trapping is terminated after four nights, even if the desired numbers of animals have not been collected. Prior to laboratory analysis of reproductive effort or stomach contents, any internal parasites and general internal condition, if other than normal, will be noted. The species which are being collected and the vegetation types being sampled are listed in Table 3-7- 62.

3) Laboratory Analysis of Reproductive Effort - The number and condition of placental scars, pigmented areas of the uterus occurring at sites of previous placental attachments, has been used to determine litter size in small mammals (Davis and Emlen, 1948; Corthum, 1967). Since placental scars become increasingly lighter with age (Crothum, 1967), the degree of scar pigmentation can be used to indicate the approximate date of birth. Thus, by examining the reproductive tract of adult females of selected species at times during the breeding season, information on litter size, number of litters per season, and date of birth can be provided.

The laboratory procedures for examining placental scars involve removal of the female reproductive tract, which is placed in a watch glass filled with water. The uterus is stretched to insure that all scars become visible, and a count is made and recorded on a standard data sheet (Figure 3-7-29). If the female is pregnant, fetuses are counted.

4) Laboratory Analysis of Stomach Contents - Basic dietary preferences of small mammal species are becoming well-studied by mammalogists and a solid literature base is developing which can be employed to support interpretation of trophic relationships of mammals within various plant communities. The International Biological Program's Grassland Biome work has provided recent data on small mammal diets through its Diet Laboratory in Fort Collins (e.g., Grant, 1972; Hansen and Moir, 1971; Flinders and Hansen, 1972). These data will be utilized whenever feasible to support interpretation of dietary habits and trophic level position of the small mammal species found on or near Tract C-a.

Stomach contents of animals are emptied into a Petri dish containing water and examined under 30 x magnification through a dissecting stereoscope. The particle on or closest to a mark in the center of the dish is characterized as to whether it is of arthropod, vertebrate or vegetal origin, and then recorded on a data form (Figure 3-7-30). Vegetation is differentiated into seeds and succulent parts. A total of 50 particles are examined for each stomach; dish contents are sufficiently agitated between examinations to ensure randomization.

5) Collection of Voucher Specimens - To confirm field identification and to provide evidence of species encountered during the baseline inventory, up to five voucher specimens of each small mammal species captured are being prepared. Voucher specimens, provided by both the removal and live trapping programs, are being processed and curated by ECI personnel. Identifications are checked by Dr. Robert B. Finley, a mammalogist with the National Fish and Wildlife Laboratory, familiar with the mammals of western Colorado.

6) Pitfall Trapping - Pitfall traps for "trap-shy" animals and for small mammals not attracted to peanut butter bait are established in each of the vegetation communities sampled by the live trapping grids and in the riparian habitat beside the pond in Stake Springs Draw (Figure 3-7-27). The trap system consists of the placement of three plastic buckets (approximately the size of number 10 cans) in the ground open end up, flush with the ground surface and in a straight line. A 0.3 m high drift fence (wire window screen) stretched over the center of the cans guides animals into the traps (Figure 3-7-31). A thin coating of glycerin is deposited on the bottom to minimize the possibility of small animals jumping out of the trap cans. Three trap systems are established at each site and operated for 4 days during each small mammal live trapping period. All pitfalls are inspected daily for captures.

Species, sex, age, habitat type and pitfall location are recorded for each captured animal on a standard field data form (Figure 3-7-32). Up to five individuals of each species found dead in the traps are being prepared as voucher specimens, while live animals are released.

7) Night Spotlight Census - A night spotlight census route has been established to record activity, distribution, and abundance of nocturnally active mammals, particularly lagomorphs and other medium-sized mammals. This census is being conducted on two clear nights during February, June and October of each year along a 48.4 km (30 mi) route which traverses all major vegetation associations within and adjacent to Tract C-a (Figure 3-7-33).

The route is driven at approximately 16.1 km (10 mi) per hour with an observer situated on the passenger side of the vehicle operating a spotlight. All mammals sighted within a strip up to 25 m (82 ft) wide on the right side and in front of the vehicle are being recorded to species. Odometer readings to the nearest 0.16 km (0.1 mi) are recorded at the start of the census and each time a mammal is observed. Habitat is also noted. All data are recorded on a standard field data sheet (Figure 3-7-34).

Because of variations in topography and vegetation density it is not possible to census accurately all active mammals within a 25 m strip. To account for these variations the "observable distance", up to 25 m in each 0.6 km portion of the survey route is estimated to the nearest 1.0 m. Multiplying mean width (observable distance) times length provides an estimate of the total area sampled by the night spotlight census route. The number of animals sighted divided by the area sampled gives an estimate of density per unit area.

8) Bat Investigations - During the summer months of June and August, 1975 and 1976, ECI employs two techniques to determine the distribution and relative abundance of bat species within and adjacent to Tract C-a.

During daylight hours old buildings, rock overhangs, crevices and other likely places are searched for roosting bats. Active bats are sampled at dusk by capturing foraging individuals over ponds. On four consecutive neights during the sampling periods, mist nets are placed in a vertical position with the bottom shelf less than 0.3 m (1 ft) above ponds or water tanks. Bats striking the net while sweeping low over the water to drink are captured in the pocket of the net. The mist net is examined as often as necessary to prevent escape or death of captured bats. Sampling is discontinued when no bats are observed for 1/2 hour. The first individual of each species captured is sacrificed and prepared as a voucher specimen. For subsequent captures, the species and sex of the animal, the date and location of sampling and the collector's name are recorded on a standard field data sheet (Figure 3-7-35). The bat is then released.

b. Data Analysis

1) Live Trapping

a) Population Density Estimates - The Jolly-Seber stochastic model is used for calculating density of small mammal populations from data obtained on the live-trapping grids. This procedure can be applied to multiple capture-recapture data when the population is subject to possible death, recruitment, immigration or permanent emigration during or between sampling periods (Cormack, 1968). This general model also allows for accidental deaths due to trapping, marking or handling. The method, proposed independently by Jolly (1965) and Seber (1973), assumes the following:

- Every animal in the population, whether marked or unmarked, has the same probability of being captured in the i^{th} sample.
- Every marked animal has the same probability of surviving from the i^{th} to the $(i+1)^{th}$ sample and of being in the population at the time of the i^{th} sample.
- Marked animals do not lose their marks and all marks are reported.
- All samples are instantaneous; i.e., the time it takes to run a grid is negligible (Seber, 1973).

The marked population at time i, M_i, is adjusted for the effects of death, recruitment, and emigration by the following equation:

$$\hat{M}_i = z_i \frac{s_i}{r_i} + m_i$$

Where: s_i = number of animals released at time i,
r_i = number of s_i which are recaptured subsequently,
z_i = number of individuals marked before time i and not caught at time i, but which are recaptured subsequently, and
m_i = number of marked animals captured at time i.

From $\hat{M}_i$ an estimate of the population size at time i (N_i) is obtained by:

$$\hat{N}_i = \frac{\hat{M}_i n_i}{m_i}$$

Where: n_i = the number of animals caught in the i^{th} sample.

This model also provides estimates of $\hat{P}_i$, the probability an animal alive at time i is captured at time i, $\emptyset_i$; the probability an animal alive at time t_i survives to t_{i+1}; and B_i, the number of new animals joining the population in the interval from t_i to t_{i+1} (Jolly, 1965). These estimates are given by:

$$\hat{P}_i = n_i/\hat{N}_i = (m_i/\hat{M}_i)$$

$$\hat{\emptyset}_i = \frac{\hat{M}_i+1}{\hat{M}_i - m_i + s}$$

$$\hat{B}_i = \hat{N}_{i+1} - \emptyset\ (\hat{N}_i - n_i + s_i)$$

The estimated variances of $\hat{\emptyset}_i$ and $\hat{B}_i$, and the error of estimation of $\hat{N}_i$, are obtained by substituting the estimated or observed values for the symbols in the expressions given below .

$$v(\hat{N}_i/N_i) = N_i(N_i - n_i) \left[\frac{(M_i - m_i + s_i)}{M_i} \quad (\frac{1}{r_i} - \frac{1}{s_i}) + \frac{(N_i - M_i)}{m_i N_i} \right]$$

$$\mathrm{Var}\ (\hat{\emptyset}_i) = \emptyset_i^2 \left[\frac{(M_{i+1} - m_{i+1})\ (M_{i+1} - m_{i+1} + s_{i+1})}{M^2_{i+1}} \right.$$

$$(\frac{1}{r_{i+1}} - \frac{1}{s_{i+1}}) + \frac{(M_i - m_i)}{(M_i - m_i + s_i)} \quad (\frac{1}{r_i} - \frac{1}{s_i}) +$$

$$\left. \frac{(1-\emptyset_i)}{m_{i+1}} \right]$$

$$\mathrm{Var}(\hat{B}_i) = \frac{B_i^2 (M_{i+1} - m_{i+1})(M_{i+1} - m_{i+1} + s_{i+1})}{m^2_{i+1}} \left(\frac{1}{r_{i+1}} - \frac{1}{s_{i+1}}\right) +$$

$$\frac{(M_i - m_i)}{(M_i - m_i + s_i)} \frac{\emptyset_i^2 s_i^2 (N_i - M_i)^2}{M_i^2} \left(\frac{1}{r_i} - \frac{1}{s_i}\right) +$$

$$\frac{(N_i - m_i)(N_{i+1} - B_i)(N_i - M_i)(1 - \emptyset_i)}{M_i (M_i - m_i + s_i)} +$$

$$N_{i+1} (N_{i+1} - n_{i+1}) \frac{(N_{i+1} - M_{i+1})}{M_{i+1} m_{i+1}} + \emptyset^2{}_i N_i (N_i - n_i) \frac{(N_i - M_i)}{M_i m_i}$$

When m_i and r_i are both greater than 10, Seber (1973) suggests modifications of $\hat{M}_i$, $\hat{N}_i$, $\hat{O}_i$, and B_i which lead to less biased estimates. These modified estimates are:

$$\hat{M}_i = z_i \frac{s_i + 1}{r_i + 1} + m_i$$

$$\hat{N}_i = \frac{\hat{M}_i (n_i + 1)}{m_i + 1}$$

$$\hat{\emptyset}_i = \frac{\hat{M}_{i+1}}{\hat{M}_i - m_i + s}$$

$$\hat{B}_i = \hat{N}_{i+1} - \hat{\emptyset}_i (\hat{N}_i - n_i + s_i)$$

These corrections for sampling bias will not affect the estimates of variance (Seber, 1973).

Since portions of some animals' home range lie outside the small mammal live trapping grids, the grid boundaries do not circumscribe the actual area being sampled. The effective trapping area, which depends on trapping efficiency

and animal movement patterns, must be estimated to provide absolute density estimates (animals per unit area) for the sampled small mammal populations. Addition to the boundaries of the grid of an area equal to the radius of the average home range of a particular animal category furnishes an estimate of the effective trapping area (Broadbooks, 1970).

Home range may be defined as that area traversed by the individual in its normal activities of food gathering, mating, and caring for young (Burt, 1943). Occasional excursions outside the area are specifically excluded from the concept of home range. Food supply, cover, population density, territorality and other factors may influence the size of home ranges.

Stickel (1954) reviews and compares several methods of estimating home range. One method, the observed maximum range length method, uses the distance between the most widely separated capture sites as the diameter of a circle for which an area is computed. Stickel (1954) found that adding one half the distance to the next trap to each end of the observed maximum range length (the adjusted maximum range length) gave estimates within 3% of the true range length in an artificial population. The maximum observed range length and adjusted maximum range length have been used by several authors to compute home range of small mammals (Lidicker, 1966; Stickel, 1960; Brown, 1956; Fitch, 1947; Linsdale, 1946; Lay, 1942; Stuewer, 1943; Evans and Holdenried, 1943).

Adjusted maximum range lengths, then, are calculated and averaged over age and sex classes of all individuals of each species captured at three or more different locations at each 7.29 and 1.35 ha grid during one sampling period. To insure comparability of data between species and among grids, the adjusted maximum range length is computed only from the first three captures at different locations regardless of the total number of captures. A boundary strip equal to one-half of the average adjusted maximum range length is added to the grid area as an estimate of the effective trapping area for each species. Dividing the Jolly-Seber population estimates by the estimated effective trapping area provides population density estimates for each species captured on the larger grids.

b) Habitat Affinity - Small mammal species depend upon their immediate surroundings to provide basic requirements for food, shelter and water. Determination of habitat affinities within the normal range of a species may indicate its particular needs for survival and continued growth and reproduction. In general, an animal's habitat may be characterized by the predominant vegetation. Evaluation of distribution abundance patterns of different animal species within and between vegetation types provides a measure of habitat affinity.

If all animal species in an area were randomly distributed with respect to vegetation distribution (no habitat affinity), then the proportion of individuals of a species captured in a particular vegetation type would correspond to the proportion of the trapping effort devoted to that vegetation type. For example, if 30% of the small mammal live traps were established in sagebrush vegetation type, then 30% of the total number of individuals of all species captured over all sampling grids would be caught in the sagebrush habitat if the species were randomly distributed. Conversely, if 90% of all sagebrush vole captures occurred in the sagebrush this would indicate a definite affinity of sagebrush voles with sagebrush stand vegetation.

The chi-square test (Snedecor and Cochran, 1967) will be used to determine if the differences between the observed number of captures for a given species in a given vegetation type and the number of captures expected on the basis of a random distribution is significant. The chi-square statistic, χ^2 is given by:

$$\chi^2 = \Sigma \frac{(O-E)^2}{E}$$

Where: O = observed number of captures

E = expected number of captures based on a random distribution

The calculated total chi-square value is compared to a chi-square table. If the value exceeds 22.36 (for 13 degree of freedom) a significant difference at the 95% confidence level exists between observed and expected number of

captures. When a significant total chi-square value is obtained, each individual value (species by habitat) is chedked to determine where the deviation(s) from a random pattern occurs. The individual values indicate the degree of deviation (the larger the value the greater the deviation from normal). The sign associated with the value indicates whether the deviation is greater or less than expected.

c) Species Diversity - Species diversity is a measurable characteristic which relates to the organization and functioning of the ecosystem (MacArthur, 1965; Pianka, 1971). It incorporates both the number of species and the number of individuals of each species present in a sample taken from a community.

One diversity index which has been widely applied to community analysis is the Shannon-Weiner function, H' (Margalef, 1957; MacArthur and MacArthur, 1961; Lloyd and Ghelardi, 1964; Pielou, 1966). This function, derived from the field of information theory, describes the average degree of uncertainty of predicting the species of a given individual picked at random from a community. This uncertainty and the value of the index increases both as number of species and the equitability of distribution of individuals among species increases.

The general formula for the index is:

$$H' = -\sum_{i=1}^{s} P_i \ln P_i$$

where s is the number of species and p_i is the proportion of the total number of individuals consisting of the ith species. Logarithms to the base e are generally used. The above equation is a biased estimate of H', an unbiased estimate, E(H'), can be found from (Hutcheson, 1970):

$$E(H') = \sum_{i=1}^{s} p_i \ln p_i - \frac{s-1}{2N}$$

where N is the total number of individuals of all species. Natural logarithms must be used in this formula.

The variance of the estimate of H' is estimated by:

$$\text{Var}(H') = \frac{\sum_{i=1}^{s} p_i \ln^2 p_i - \left(\sum_{i=1}^{s} p_i \ln p_i\right)^2}{N}$$

The maximum value of H' that could be expected if all individuals captured were distributed evenly among the species is estimated by:

$$H' (\max) = \log s$$

The evenness of distribution or equitability then is calculated by the formula:

$$J = H'/H' (\text{maximum})$$

2) Night Spotlight Census - Density estimates (numbers per hectare) are determined for each species observed during the night spotlight census. The total area covered during the census is determined by multiplying the mean transect width (average observable distance) by the transect length (48,270 m). Dividing the area covered, after conversion to hectares, into the total number of a particular species seen provides an estimate of the number of animals per hectare.

3. Data Summary

a. Live and Removal Trapping - Fourteen different vegetation types were sampled by small mammal live trapping grids during October and December 1974 and during May, July and September-October 1975. Small mammal grid designations and habitat descriptions for each grid are listed in Table 3-7-63 . Removal trap lines were established in vegetation types sampled by grids A-E and G during December 1974 and May, July and October, 1975 to collect adult deer mice (*Peromyscus maniculatus*), least chipmunks (*Eutamias minimus*) and long-tailed voles (*Microtus longicaudus*) for analyses of reproductive efforts and stomach contents.

Approximately 2,700 small mammals representing 13 different trappable species have been captured to date. The species encountered are included in the wild mammal species list presented in Table 3-7-64 .

Data collection from small mammals captured during trapping operations are summarized and presented below. Three major topics are considered. First, the relative importance of each habitat type to the diversity and abundance of small mammal population is discussed. Secondly, the ecological distribution, abundance, and variation of population parameters among habitats is described for each small mammal species captured. Finally, seasonal variations in small mammal population levels are discussed.

1) Small Mammal Habitats - Determination of the relative importance of different habitats to small mammal populations will focus on a comparison of three esitmated parameters: species diversity, species composition and abundance.

Shannon-Weiner diversity indices are provided for each grid (habitat type) during each sampling period in Tables 3-7-65 to 3-7-70. The diversity indices express numerically the number of species and distribution of individuals among species (equitability) for each grid. Since an increased trapping effort usually results in the capture of more species and more individuals among species, direct comparison of results cannot be made between small (0.81 ha) and larger (1.35 and 7.29 ha) grids.

A summary of trapping results, expressed as individuals of all species captured per 100 trap nights, is presented for all grids during each sampling period in Table 3-7-71. Expressing abundance as captures per 100 trap nights where one trap night is defined as a trap baited and set for approximately 24 hours permits direct comparison of results of each grid type and between sampling periods.

A trapping summary by species for all grids is shown in Table 3-7-72 . Macrohabitat affinities as determined by chi-square values are presented for each species in Table 3-7-73 . A total chi-square value greater than 22.36 represent

Table 3-7-70 Number of species captured (n) and Shannon Weiner indices (H') for each grid by trapping period (October 1974 - September/October 1975).

Grid	Vegetation Type	Oct. 1974 n	Oct. 1974 H'	Dec. 1974 n	Dec. 1974 H'	May 1975 n	May 1975 H'	July 1975 n	July 1975 H'	Sept/Oct. 1975 n	Sept/Oct. 1975 H'
1	Bottomland meadow	2	.349	3	.908	2	.500	2	.500	1	(0
2	Sagebrush (flat)	2	.687	1	(0	3	.967	4	1.047	3	.718
3	Rabbitbrush	3	.745	2	.440	3	.894	3	0.619	3	.455
4	Pinyon-juniper/mixed brush	3	.980	1	(0	4	1.001	3	1.038	4	.971
5	Mixed brush	2	.665	2	.693	2	.642	2	.683	2	.655
6	Pinyon-juniper/sagebrush	3	.673	1	(0	3	.935	4	1.133	2	.295
7	Upland meadwo	2	.349	0	--*	2	.500	2	.520	1	(0
A	Greasewood/sagebursh	3	.950	3	.773	3	.849	4	1.040	5	.970
B	Pinyon-juniper (south slope)	5	1.182	2	.393	6	1.440	7	1.634	7	1.296
C	Pinyon-juniper (north slope)	7	1.231	2	.693	5	1.331	6	1.477	6	1.314
D	Sagebrush	5	.981	1	(0	4	.998	4	1.165	4	.721
E	Mixed brush	4	.857	0	--*	5	1.046	5	1.137	5	.764
F	Douglas-fir	2	.398	2	.271	2	.645	2	.693	4	1.147
G	Aspen		1.028			3	.810	3	.613	4	1.245

* Insufficient data for computation

Table 3-7-71 Small mammal trapping summary for all grids during each sampling period for RBOSP

		Individuals captured of all species per 100 trap nights						
Grid	Vegetation Type	Oct. 1974	Dec. 1974	May 1975	July 1975	Oct. 1975	Average	% Relative Abundance
1	Bottomland Meadow	10.91	14.55	6.67	5.05	3.64	8.43	4.65
2	Sagebrush	10.91	4.85	13.33	20.61	17.58	13.45	7.42
3	Rabbitbrush	23.64	15.15	35.76	12.73	23.03	22.06	12.17
4	Pinyon-juniper/mixed brush	24.24	2.42	22.42	13.33	12.73	15.03	8.29
5	Mixed Brush	20.61	1.21	23.03	8.48	33.33	17.33	9.56
6	Pinyon-juniper/sagebrush	18.18	6.06	21.21	15.15	13.94	14.91	8.22
7	Upland Meadow	5.45	0.00	9.09	8.48	9.70	6.55	3.61
A	Greasewood/Sagebrush	22.26	12.73	12.33	12.63	26.47	18.09	9.98
B	Pinyon-juniper (south slope)	16.54	9.09	14.14	16.09	14.44	14.94	8.24
C	Pinyon-juniper (north slope)	15.04	1.21	9.02	14.59	11.23	11.82	6.52
D	Sagebrush	15.34	1.21	9.77	7.97	6.47	9.38	5.17
E	Mixed Brush	8.57	0.00	13.08	11.13	17.44	11.82	6.52
F	Douglas Fir	8.98	7.88	8.52	7.21	8.85	8.30	4.58
G	Aspen	*	*	10.49	6.56	10.49	9.18	5.06
	Average	15.39	5.87	12.71**	11.37**	14.52**	13.07	
	% Relative Abundance	25.70	9.81	21.23	18.99	24.26		

* Grid not sampled.

** For comparative purposes, Aspen data are not included in averages.

Table 3-7-72 Small mammal trapping summary by species for all grids during sampling periods 1, 3, 4, and 5* for RBOSP

Grid	Vegetation Type	SOME	SPLA	SPTR	PEAP	EUMI	EUQU	PEMA	PETR	NECI	CLGA	MIMO	MILO	LACU
		Number of individuals captured of each species** per 100 trap nights												
1	Bottomland Meadow	0.00	0.00	0.00	0.00	0.34	0.00	5.56	0.00	0.00	0.00	0.51	0.00	0.34
2	Sagebrush	0.00	0.00	1.82	0.15	9.70	0.00	3.94	0.00	0.00	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.91	0.00	0.00	8.94	0.00	13.64	0.00	0.00	0.00	0.00	0.30	0.00
4	Pinyon-juniper/ mixed brush	0.00	0.91	0.00	0.15	7.58	1.67	7.88	0.00	0.00	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.00	0.00	0.00	13.18	0.00	8.18	0.00	0.00	0.00	0.00	0.00	0.00
6	Pinyon-juniper/ sagebrush	0.00	0.91	0.00	0.45	4.70	0.00	11.06	0.00	0.00	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.00	0.00	0.00	1.06	0.00	7.12	0.00	0.00	0.00	0.00	0.00	0.00
A	Greasewood-Sagebrush	0.00	0.68	0.00	0.08	8.53	0.00	8.16	0.00	0.00	0.00	0.00	0.98	0.00
B	Pinyon-juniper (south slope)	0.00	1.20	0.00	0.19	6.39	1.43	4.59	0.64	0.83	0.00	0.04	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	1.58	0.00	0.00	4.17	1.39	4.70	0.38	0.23	0.00	0.04	0.00	0.00
D	Sagebrush	0.04	0.90	0.00	0.00	4.02	0.00	4.51	0.00	0.11	0.00	0.00	0.00	0.30
E	Mixed brush	0.00	0.53	0.00	0.00	5.64	0.00	5.68	0.00	0.00	0.08	0.00	0.19	0.45
F	Douglas Fir	0.00	0.00	0.00	0.00	2.41	0.00	1.38	0.00	0.00	4.48	0.00	0.09	0.00
G	Aspen	0.00	0.00	0.00	0.00	2.51	0.00	1.42	0.00	0.00	4.92	0.00	0.33	0.00
	Average	0.01	0.74	0.06	0.06	5.60	0.43	5.72	0.14	0.16	0.50	0.03	0.19	0.11
	% Relative Abundance	0.04	5.41	0.44	0.44	40.80	3.14	41.65	0.99	1.13	3.62	0.18	1.35	0.80

* Winter sampling period deleted from analysis due to the inactivity of most small mammal species during this time.

** See Table for species represented by each 4-letter code.

Table 3-7-4 Determination of macrohabitat preferences by chi-square values* for all species captured on each grid during sampling periods 1, 3, 4, and 5** for RBOSP

Grid	Vegetation Type	Species***										
		SPLA	SPTR	PEAP	EUMI	EUQU	PEMA	PETR	NECI	CLGA	MILO	LACU
1	Bottomland Meadow	4.41-	0.36-	0.36-	29.38-	2.56-	0.03-	0.80-	0.92-	2.95-	1.10-	2.76+
2	Sagebrush	4.90-	338.74+	0.91+	19.78+	2.85-	3.64-	0.89-	1.03-	3.28-	1.23-	0.73-
3	Rabbitbrush	0.25+	0.40-	0.40-	13.14+	2.85-	72.46+	0.89-	1.03-	3.28-	0.49+	0.73-
4	Pinyon-juniper/mixed brush	0.25+	0.40-	0.91-	4.60+	23.33+	5.41+	0.89-	1.03-	3.28-	1.23-	0.73-
5	Mixed brush	4.90-	0.40-	0.40-	67.75+	2.85-	7.03+	0.89-	1.03-	3.28-	1.23-	0.73-
6	Pinyon-juniper/sagebrush	0.25+	0.40-	17.04+	0.96-	2.85-	33.00+	0.89-	1.03-	3.28-	1.23-	0.73-
7	Upland meadow	4.90-	0.40-	0.40-	24.28-	2.85-	2.38+	0.89-	10.3-	3.28-	1.23-	0.73-
A	Greasewood-sagebrush	0.16-	1.60-	0.10+	40.89+	11.48-	27.77+	3.60-	4.14-	13.21-	89.82+	2.94-
B	Pinyon-juniper (south slope)	7.59+	1.60-	7.21+	2.97+	61.28+	5.93-	49.80+	77.11+	13.21-	4.94-	2.94-
C	Pinyon-juniper (north slope)	25.05+	1.60-	1.60-	9.67-	56.74+	4.80-	11.35+	0.84+	13.21-	4.94-	2.94-
D	Sagebrush	0.91+	1.60-	1.60-	11.82-	11.48-	6.75-	3.60-	0.31-	13.21-	4.94-	8.73+
E	Mixed Brush	1.68-	1.60-	1.60-	0.01+	11.48-	0.01-	3.60-	4.14-	9.52-	0.00+	27.98+
F	Douglas-fir	8.61-	0.70-	0.70-	21.03-	5.01-	38.16-	1.57-	1.80-	371.01+	0.62-	1.28-
G	Aspen	6.80-	0.55-	0.55-	15.56-	3.95-	29.53-	1.24-	1.42-	360.05+	1.00+	1.00-
	TOTAL	70.65	350.35	33.79	261.86	201.55	236.78	80.94	96.85	816.05	113.97	54.93

* A total chi-square value greater than 22.36 indicates a significant difference between expected and observed number of captures at the 95% confidence level. A '+' following a value signifies that the observed number of captures exceeded the expected number while a '-' implies the opposite.

** Winter sampling period deleted from analysis due to inactivity of most small mammal species during this time.

*** See Table 3-7-64 in the Second Annual Report for species represented by each 4-letter code.

a statistically significant difference between the observed and expected (based on a random distribution of species among habitat types) number of captures. Habitat affinities are indicated by the largest positive values of a species individual chi-square value series.

Most small mammals ultimately depend upon the vegetation for their cover, source of food and frequently their only supply of water. The amount of vegetation cover within a habitat type therefore is probably a major determining factor in the distribution and abundance of many small mammal species. To help identify causal relationships between vegetation and small mammal population parameters, percent cover of all vegetation within the tree, shrub, and herbaceous strata at each small mammal grid are presented in Table 3-7-74 . Percent cover was determined from data collected on permanent vegetation phytosociological transects established on or near the appropriate small mammal grid.

a) Bottomland Meadow (Grid 1) - Species diversity on grid 1 was comparatively low during most sampling periods with no more than three species represented in any one sample. The deer mouse was the most frequently trapped small mammal on the grid. The least chipmunk, montane vole, and the sagebrush vole (*Lagurus curtatus*) were also captured.

Percent relative abundance of trappable small mammals, based on the average trapping success per unit effort (i.e., 100 trap nights) over all sampling periods, was the third lowest (4.65%) among grids. This is probably due in large part to the total absence of tree cover, and very little shrub cover (0.27%) on the grid although herbaceous cover (67.93%) was the highest of all grids. As the results from other grids will emphasize the amount of tree and shrub cover, particularly shrub cover, is an important factor which influences total small mammal abundance. A dense shrub cover definitely affords a great deal of protection, many potential nesting sites and a source of food.

Table 3-7- Percent cover of tree, shrub and herbaceous vegetation on or near each small mammal live trapping grid as determined from data collected on permanent phytosociological transects for RBOSP

		% Cover-all vegetation species			
Grid	Vegetation Type	Tree	Shrub	Herbaceous*	Total
1	Bottomland meadow**	--	0.27	67.93	65.20
2	Sagebrush**	--	21.43	7.32	28.75
3	Rabbitbrush***	--	35.53	22.95	58.48
4	Pinyon-juniper/mixed brush**	1.75	24.30	10.45	36.50
5	Mixed brush**	--	51.31	8.52	59.83
6	Pinyon-juniper/sagebrush**	--	25.75	25.85	51.60
7	Upland meadow**	--	--	20.88	20.88
A	Greasewood-sagebrush***	--	39.88	9.43	49.31
B	Pinyon-juniper (south slope)***	13.05	1.37	3.57	17.99
C	Pinyon-juniper (north slope)**	28.50	1.00	1.77	31.27
D	Sagebrush***	--	32.97	13.43	46.40
E	Mixed brush**	--	74.36	5.82	80.18
F	Douglas Fir***	30.45	57.01	20.67	108.13
G	Aspen***	34.92	59.43	26.23	120.58

* Average of 3 sampling periods (' , July, and September, 1975).

** Vegetation transect is within a comparable vegetation type near the small mammal grid.

*** All or a portion of the vegetation transect is within the small mammal grid.

b) Sagebrush (Grid 2) - Species diversity was on the average higher on this grid located on 84 Mesa than that of bottomland meadow with as many as 4 species captured in one sample. The least chipmunk and the deer mouse were captured more frequently than other species and the former species exhibited an affinity for this sagebrush type. The apache pocket mouse (Perognathus apache), and the thirteen-lined ground squirrel (Spermophilus tridecemlineatus) were also represented in samples. The latter species exhibited a very definite affinity for this habitat type.

Although herbaceous vegetation cover was relatively low (7.32%), shrub cover (21.43%) was much higher than that for bottomland meadow. Accordingly, total percent relative abundance (7.42%) was higher.

c) Rabbitbrush (Grid 3) - Species diversity was very low on this grid as most of the individuals captured were either deer mice or least chipmunks. Both species exhibited an affinity for this type. The golden-mantled ground squirrel (Spermophilus tridecemlineatus) and the long-tailed vole were also captured on the grid but were represented infrequently in samples.

Total percent relative abundance (12.17%) was the highest of any grids sampled. The high shrub (35.53%) and herbaceous (22.95%) cover were probably major contributing factors to the high capture success in this habitat type. In fact, only two other grids, grid A (greasewood-sagebrush) and grid 5 (mixed brush), both in comparable elevational zones and with a higher shrub cover and similar relative abundances, exhibited a much lower herbaceous cover, 8.52 and 9.43, respectively.

d) Pinyon-juniper (mixed brush) - The ecotonal (edge habitat) characteristics and the presence of trees are probably two important factors which resulted in a moderately high average species diversity value for this grid.

The Colorado chipmunk (Eutamias quadrivittatus), whose distribution is limited to the pinyon-juniper type within the study area was caught here. Although its relative abundance was low compared to the least chipmunk and the deer mouse, the Colorado chipmunk revealed an affinity for this habitat type as did the latter two species. The golden-mantled ground squirrel and the apache pocket mouse were occasionally captured.

The total percent relative abundance (8.29%) was the fourth highest of all grids. The moderately high shrub cover (24.30%), herbaceous cover (10.45%) and the presence of a tree stratum probably accounted for the high relative abundance.

e) Mixed Brush (Grid 5) - Species diversity was relatively low on this grid during all sampling periods as only two species were ever captured. Both the deer mouse and the least chipmunk were trapped frequently in traps and both exhibited a definite affinity for the habitat type.

This grid exhibited the highest shrub cover (51.31%) of all grids established at lower elevations. Accordingly, total percent relative abundance (9.56%) was the third highest of all grids. It appears from the comparison of trapping results from homogeneous mixed brush and sagebrush types (grids 5,2, and D) at the lower elevation that mixed brush can support more small mammals than sagebrush. Thus, in some instances, vegetation species composition may be as important to small mammal diversity and abundance as vegetation cover.

f) Pinyon-juniper/sagebrush (Grid 6) - Although this grid is similar to grid 4 (pinyon-juniper/mixed brush) in that it is a pinyon-juniper/shrub ecotone, species diversity was on the average lower. The largest contributing factor to the decreased diversity was the predominance of deer mice and the total absence of the Colorado chipmunk. The deer mice as well as the apache pocket mouse showed an affinity forthis habitat type. The golden mantled ground squirrel was captured occasionally on the grid.

Although both shrub cover (25.27%) and herbaceous cover (25.85%) were higher on this grid than on grid 4, total relative abundance was lower (8.22%).

g) Upland Meadow (Grid 7) - Species diversity here was, on the average, the lowest of all small grids. Only 2 species, the least chipmunk and the deer mouse, were represented in samples and neither exhibited a preference for the type.

Total percent relative abundance (3.61%) was the lowest of all grids. The absence of trees and shrubs and the harsh environmental conditions characteristic of the higher elevations were undoubtedly the major contributing factor in the poor trapping success shown by this grid.

h) Greasewood-sagebrush (Grid A) - This grid exhibited the lowest average species diversity of the larger grids establshed in habitats below 7500 ft elevation. Although five species were trapped, most individuals captured were either deer mice or least chipmunks. Both species exhibited a preference for this habitat type as did the long-tailed vole (Microtus longicaudus). The golden-mantled ground squirrel and the Apache pocket mouse were captured infrequently.

Total percent relative abundance (9.98%) was the highest of the larger grids and second highest of all grids. Again, high shrub cover (39.88%) appears to be a major contributing factor even though herbaceous cover (9.43%) was low.

i) Pinyon-juniper/south slope (Grid B) - This grid exhibited the highest species diversity of any of the large (7.29 ha) grids. A total of 8 species were trapped on this grid. Five of these species, the golden mantled ground squirrel, Apache pocket mouse, bushy-tailed wood rat (Neotoma cinerea), Colorado chipmunk and pinyon mouse (Peromyscus truei) exhibited an affinity for the habitat type. The latter two species are limited to pinyon-juniper woodlands within the study area. The least chipmunk, montane vole and the deer mouse were also captured.

Though shrub cover (1.37%) and herbaceous cover (3.57%) were low, total percent relative abundance (8.24%) was moderately high on this grid. The presence of trees evidently was important to small mammal abundance here.

j) <u>Pinyon-juniper/north slope (Grid C)</u> - Again, largely due to the presence of the tree stratum, average species diversity was high on this grid. With the absence of the apache pocket mouse, the same species were captured on this grid as on grid B. However, only 3 species, the golden-mantled ground squirrel, Colorado chipmunk, and the pinyon mouse showed a definite affinity for this habitat type.

Tree cover (28.50%) was higher on this grid than on grid B thought total small mammal percent relative abundance (6.52%) was lower. This may be attributed in part to the lower shurb (1.00%) and herbaceous (1.77%) cover.

k) <u>Sagebrush (Grid D)</u> - Average species diversity on this grid was comparable to that of grid A (greasewood-sagebrush). Six species were represented in samples with the deer mouse and least chipmunk being captured more frequently even though both showed a negative affinity for the sagebrush type. The sagebrush vole revealed an affinity for this type. The golden mantled ground squirrel and the bushy-tailed wood rat were also captured.

Total relative abundance (5.17%) was the lowest of the large grids. The high shrub cover (32.97%) and the moderately high herbaceous cover (13.43%) does not support this trend. However, the absence of trees and the fact that homogeneous sagebrush types (excluding sagebrush stands in the bottomland drainings) tend to support fewer small mammals than mixed bursh types may partially explain the lower relative abundance on this grid.

l) <u>Mixed Brush (Grid E)</u> - Average diversity on this grid was comparable to the other treeless large grids, although this elevation is over 1,000 ft higher. Six species were captured with the deer mouse and the least chipmunk again most abundant. However, the only species that showed an affinity for this mixed brush type was the sagebrush vole. The red-backed vole (*Clethrionomys gapperi*) was represented by very few captures. The golden-mantled ground squirrel and the long-tailed vole were also captured.

Shrub density (74.36%) was the highest of any grid and thus total percent relative abundance was higher than grid D (sagebrush) even though the elevation was higher and the environmental conditions probably harsher.

m) Douglas-Fir (Grid F) - Average species diversity was low on this grid as most of the captures were of one species, the red-backed vole, which revealed a definite affinity for the Douglas fir vegetation type. The long-tailed vole, deer mouse and the least chipmunk were occasionally captured.

Even though tree (30.45%), shrub (57.01%), and herbaceous (20.67%) cover were very high, total percent relative abundance was the second lowest of any grid. The harsher environment and shorter growing season at the higher elevation (8200 ft) are probably major contributing factors.

n) Aspen (Grid F) - Although the same species were captured in Aspen as in Douglas-fir, the individuals captured were more equally distributed among the species and average species diversity was higher at the aspen grid. The red-backed vole revealed an affinity for this type.

Total vegetation cover was higher in Aspen than in Douglas fir and percent relative abundance was higher. However, other factors at the higher elevations including length of the growing season, harshness of the environment, vegetation species composition and tolerance range of small mammals to these factors, may be as important to small mammal abundance (and diversity) as vegetation cover.

2) Small Mammal Species Distribution and Abundance - The ecological distribution and abundance of each small mammal species encountered during trapping operations is defined below. Species macrohabitat affinities, average weights, Jolly-Seber estimates of density and other population parameters including immigration and survivability, and average range lengths (an indicator of home range size) are also provided. Reliable Jolly-Seber and range length estimates require sufficient recapture data for individuals of

a species. Accordingly, these estimates are the only provided for certain species (i.e., least chipmunk, Colorado chipmunk, deer mouse, golden-mantled ground squirrel and the red-backed vole) captured on the larger (1.35 and 7.29 ha) grids. Information on reproductive effort and food preferences obtained from least chipmunks, deer mice and long-tailed voles collected in major vegetation types during removal trapping operations is also presented. In order to facilitate reading of this section, tables on average weights, Jolly-Seber estimates, average range length, reproductive effort and food preferences habe been placed at the end of the small mammal report.

a) Merriam's Shrew (*Sorex merriami*) - Shrews are live trap shy mammals and are only occasionally captured in Sherman traps even if locally abundant. Only one shrew, a Merriam's shrew, has been captured to date during live trapping operations. The specimen was taken on grid D (sagebrush) during October, 1974. Obviously, lack of data precludes formulation of definite conclusions concerning the distribution of this species within the study area.

However, the Merriam's shrew had never been reported from the Piceance Basin prior to this capture (Robert B. Finley, National Fish and Wildlife Laboratory, personal communication). According to Lechleitner (1969) and Armstrong (1972), little is known of the habits of this shrew and nowhere does it seem to be abundant. The latter author reported that the shrew is taken most often in grasslands, open woodlands, and areas where sagebrush is the predominant vegetation.

b) Thirteen-lined Ground Squirrel (*Spermophilus tridecemileatus*) Only 12 thirteen-lined ground squirrels accounting for 0.44% of the total small mammal abundance (Table 3-7-72) have been captured during live trapping operations. This diurnal species showed a definite habitat affinity (Table 3-7-73) for the sagebrush stands on 84 Mesa as all captures occurred on the grid established in this type (grid 2) (Tables 3-7-75 - 3-7-77). The species was not represented in either October nor December, 1974 samples. The thirteen-lined ground squirrel spends the winter in a deep state of hibernation (Lechleitner, 1969) and was probably in the early stages of this hibernation in mid-October, 1974.

Average weight for this species ranged from 58 to 94 g (Tables 3-7-78 to 3-7-80); values much lower than those reported by both Armstrong (1972) and Lechleitner (1969).

c) Golden-Mantled Ground Squirrel (Spermophilus lateralis) - The golden mantled ground squirrel accounted for 5.41% of the total small mammal abundance (Table 3-7-72) and was the third most commonly encountered species during trapping operations. Although this diurnal species was captured in eight different habitats, it showed a definite affinity for only two types; pinyon-juniper/south slope (grid B) and pinyon-juniper/north slope (grid C) (Table 3-7-73). Armstrong (1972) supports this contention as he notes that relatively open woodlands (e.g., pinyon-juniper stands) and forest edge communities are preferred golden mantled ground squirrel habitat. The trapping record for the species during each sampling period is summarized in Tables 3-7-81 to 3-7-84. As with most ground squirrels, it was inactive during the winter.

A sufficient number of recaptures of individuals of the species permitted the estimation of Jolly-Seber population parameters after some trap nights for grid B (pinyon-juniper/south slope) and grid C (pinyon-juniper/north slope) (Tables 3-7-85 to 3-7-86). Table 3-7-87 defines the population parameters estimated by the Jolly-Seber method and provides the corresponding notation used in these and subsequent Jolly-Seber tables. On grid C (pinyon-juniper/north slope) estimated population densities increased from May to July, 1975. The increase does not appear to be the result of recruitment of young animals since no juveniles were captured on grid C during July (Table 3-7-83), although juveniles were encountered in other habitat types during the sampling period. The increase may be an artifact of sampling; the result of increased trapping success of golden-mantled ground squirrels during July, and not the result of a greater number of animals.

Average extended range length for this species is reported for grids B and C in Tables 3-7-88 to 3-7-89 , respectively. As only individuals captured at

least at three different locations during any one sampling period were used in the analysis, sample sizes were low. However, the golden-mantled ground squirrel does appear to have the largest home range of any rodent sampled during trapping operations. It is also one of the largest rodents (Tables 3-7-90 to 3-7-92). Since large animals require more matter and energy for their maintenance, they usually must range over larger areas to obtain it than smaller animals with otherwise similar food requirements.

d) Least Chipmunk (*Eutamias minimus*) - The least chipmunk, represented in samples from every grid, accounted for 40.8% of the total small mammal abundance and was the second most abundant species encountered during trapping operations. Although well represented in many grid samples, this diurnal species was captured most frequently on grid 5 (mixed brush) (Table 3-7-72).

The least chipmunk is the most abundant Colorado sciurid and has the widest ecological range of any sciurid in the State. It ranges from 6,000 ft to 12,000 ft in western Colorado and utilizes a variety of habitats from sagebrush plains to coniferous forests (Lechleitner, 1969). Within the area of investigation, the least chipmunk showed a definite affinity for five habitat types (Table 3-7-73) all characterized by a high shrub cover (Table 3-7-74).

The trapping results for this species during each sampling period are summarized in Tables 3-7-93 to 3-7-96. Like the golden-mantled and thirteen-lined ground squirrels, no least chipmunks were captured in live traps during the winter. Unlike the ground squirrels, however, the least chipmunk is not a true hibernator. However, it does enter periods of torpidity during cold weather and is generally inactive during the winter (Lechleitner, 1969).

Jolly-Seber population estimates were possible on all large grids (Tables 3-7-97 to 3-7-103) for the least chipmunk. Density estimates are consistently the highest on grid A (greasewood-sagebrush) and lowest on grids F (Douglas-fir) and G (aspen). Armstrong (1972) reported that this species avoids dense unbroken forest which explains the low densities in Douglas-fir and aspen.

Average extended range lengths are reported for the least chipmunks in Tables 3-7-104 to 3-7-107. The lack of consistently large sample sizes prevents the identification of any causal relationships between habitat type or seasons and home range. However, it is widely recognized that home ranges in habitats of low productivity may be larger for a particular species than in more productive habitats (Pianka, 1974). The least chipmunk does have a smaller range than the golden-mantled ground squirrel, as would be expected from its smaller body size (Tables 3-7-108 to 3-7-110).

The results of the analysis of stomach contents for least chipmunks collected during removal trapping operations are presented in Tables 3-7-111 to 3-7-112. The least chipmunk is mainly a seed-eater throughout most of the year. However, during the early spring, when seeds are not readily available and succulent vegetation is abundant, the latter food item is utilized more extensively.

The reproductive status of female least chipmunks collected during May, July and October, 1975 is shown in Table 3-7-113. Female chipmunks exhibit a single annual period of reproductive activity corresponding temporally to the males' breeding period (Skryja, 1974). The fact that 43% of the females examined in May were reproductively active, that no juveniles were trapped in May, and that juveniles were present in July live captures samples (Table 3-7-95), suggests the height of least chipmunk reproductive activity probably occurs prior to mid-July. The average litter size for least chipmunks, as reflected by the number of embryos, ranged from 4-7 with a mean of about 6 (Table 3-7-114).

e) Colorado Chipmunk (Eutamias quadrivittatus) - The Colorado chipmunk was the fifth most abundant small mammal captured, comprising 3.14% of the total abundance. Its distribution was limited to pinyon-juniper woodlands as it was only represented in samples from grid B (pinyon-juniper/south slope), grid C (pinyon-juniper/north slope) and grid 4 (pinyon-juniper/mixed brush). This diurnal species was most abundant on grid 4 but exhibited definite affinities for all three types (Table 3-7-73). Warren (1942) reported that the Colorado chipmunk inhabits forested and bushy areas in Colorado and is particularly fond of rocky ground. Armstrong (1972) reported that this chipmunk can range from 4200 ft to 10,500 ft elevation and typically inhabits areas of broken rocks and open coniferous woodland.

Trapping results for the Colorado chipmunk are presented in Tables 3-7-115 to 3-7-118. Expectedly, the species was not captured during the winter. Jolly-Seber population estimates are presented for grids B and C in Tables 3-7-119 and 3-7-120 respectively. Insufficient recapture data did not permit the estimation of population parameters for many trap nights and thus formulation of definite conclusions concerning these estimates are precluded at this time.

Average range lengths are provided in Tables 3-7-121 to 3-7-122. Average weights are shown in Tables 3-7-123to 3-7-125. As evidenced by the data, the Colorado chipmunk is slightly larger than the least chipmunk and has a larger home range.

f) Deer Mouse (Peromyscus maniculatus) - The deer mouse was the most frequently encountered small mammal during trapping operations accounting for 41.65% of the total captures (Table 3-7-72). This nocturnal species was captured in all habitat types but was most abundant in rabbitbrush (grid 3). Its habitat preferences (Table 3-7-73) are similar to those of the least chipmunk in that it shows an affinity for habitat types with a high shrub cover (Table 3-7-74).

The summary of trapping results for deer mice within each habitat type during each sampling period is shown in Tables 3-7-126 to 3-7-130.

Jolly-Seber population estimates are provided in Tables 3-7-131 to 3-7-135 for all large grids except those established in Douglas-fir and aspen. Like the least chipmunk, the highest densities for the deer mouse occurred on grid A (greasewood-sagebrush). It also occurred at high population levels on grid E (mixed brush). Both of these grids are characterized by a high shrub cover (Table 3-7-74).

Brown (1967) found the deer mouse to be most abundant in sagebrush and mountain mahogany communities in southeastern Wyoming. He suggested that these vegetation types produce large quantities of seeds suitable for consumption by deer mice. Larrison and Johnson (1973) reported deer mice to be the most abundant rodent in disturbed sagebrush and shadscale communities in Idaho.

The species commonly occurs at all elevations in Colorado from low meadows to alpine tundra (Warren, 1942) and is the most abundant of all Colorado mammals (Armstrong, 1972). Williams (1955), in surveying mice and shrew distribution in central Colorado during the summer, found the deer mouse to be common in all montane communities sampled above 8,700 ft elevation, and most abundant on disturbed areas some of which were above 9,600 ft elevation. Brown (1967) rarely captured deer mice in spruce fir forests but found them common in aspen stands in the Medicine Bow Mountains of Wyoming.

Average extended range lengths are shown for the deer mouse in Tables 3-7-136 to 3-7-139. As with the least chipmunk, samples sizes are not consistently sufficient to ascertain the relationship between habitat and home range or determine if inherent sex difference exists in the size of the home range. However, one unexpected trend is indicated by these data. Although deer mouse body weights average about 10 gm less than the least chipmunk's (Tables 3-7-140 to 3-7-142), its average range length for most sampling periods is comparable to the chipmunks. This trend is contradictory to that established by the data for other species (golden-mantled ground squirrel, Colorado chipmunk, and least chipmunk) with sufficient range length data. Thus, it appears that although the deer mouse requires less energy and matter than the chipmunk by virtue of its smaller size, it searches just as far to find it.

The results of the analysis of stomach contents of deer mice collected during removal trapping are shown in Tables 3-7-143 and 3-7-112. Like the least chipmunk, the deer mouse is primarily a seed eater. It is active the year around and appears to utilize seeds more extensively during the winter when succulent vegetation would be limited. Although the deer mouse did not appear to utilize succulent vegetation as often as the least chipmunk, it appears to be slightly more omnivorous in its food habits. Jameson (1952), in a study of the food preferences of this species in California, found that they used a wide variety of foods. In the vicinity of Tract C-a, they were the only species of the three whose stomachs were examined that utilized invertebrates or vertebrates (probably carrion) to any extent.

The reproductive status of the female deer mice collected during removal trapping is shown in Table 3-7-113. Most females examined in May were active, all were active in July and 50% were active as late as October. King (1968) reported that deer mice may experience a breeding season as long as six months and have up to 3 litters in one season. A similar length breeding season and number of litters appears to be evident here.

Average litter size, again as indicated by the average number of embryos, ranged from 4.5 to 6.7 with a grand mean of about 5.5 (Table 3-7-114). This is consistent with litter size of deer mice reported by Brown (1966) in a study in the Laramie Basin of Wyoming.

g) Piñon Mouse (*Peromyscus truei*) - Only 27 piñon mice were captured during all trapping periods and these accounted for less than 1% of the total small mammal captures. Its distribution was limited to pinyon-juniper woodlands as it was only captured at 2 grids, grid B (pinyon-juniper/south slope) and grid C (pinyon-juniper/north slope) (Table 3-7-72). It was captured more frequently on grid B but showed definite affinities for both habitat types (Tables 3-7-73).

The trapping results for the nocturnal piñon mouse are summarized for each sampling period in Tables 3-7-144 to 3-7-148. In Colorado, this species is noted as being common only in pinyon-juniper below 7,000 ft elevation (Lechleitner, 1969) but has been reported as an uncommon occurrence in pinyon-juniper up to 8,500 ft elevation in western Colorado (Armstrong, 1972). Douglas (1969) indicated that the piñon mouse is generally restricted to pinyon-juniper woodlands because it is dependent on the juniper for nesting sites and juniper berries as its preferred winter food.

Average weights for this species are provided in Tables 3-7-149 to 3-7-151. The piñon mouse appears to be slightly larger than its congener the deer mouse.

h) Bushy-tailed Woodrat (*Neotoma cinerea*) - The bushy-tailed woodrat was the seventh most frequently encountered small mammal during trapping operations. This nocturnal species was captured on three different grids,

grid B (pinyon-juniper/south slope), grid C (pinyon-juniper/north slope), and grid D (sagebrush) (Table 3-7-72). Most of the woodrats were captured on grid B, and the species showed a definite affinity for this habitat type (Table 3-7-73).

The trapping results for the bushy-tailed woodrat are shown in Tables 3-7-152 to 3-7-155. The species was not captured during the winter sampling period though Lechleitner (1969) reported that this woodrat does not hibernate.

Bushy-tailed woodrat nests were frequently seen throughout the study area in crevices in vertical cliffs or other high rock outcrops. However, the species may select den sites in a variety of locations (Lechleitner, 1969). On grid B (pinyon-juniper/south slope) where bushy-tailed woodrats were most frequently captured, nest sites were most often observed at the base of live juniper trees. Stones (1960) examined 233 woodrat houses on west-central Utah and found that 90% were in direct association with live junipers.

Average weights for this species are reported in Tables 3-7-156 to 3-7-158. The bushy-tailed woodrat is the largest small mammal species in the study area with adult body weights ranging from 130-200 gm.

i) Red-Backed Vole (Clethrionomys gapperi) - The red-backed vole was one of four vole species encountered during trapping but was the most abundant vole, accounting for 3.62% of the total number of small mammals encountered (Table 3-7-72). The species was captured on three grids, grid E (mixed brush), grid F (Douglas-Fir) and grid G (aspen), all above 8,000 ft. Warren (1942) reported that the red-backed vole rarely occurs below 8,000 ft elevation and Armstrong (1972) stated that this boreal forest species is usually confined to well-developed coniferous zones from 3,000 to 11,000 ft in Colorado. Williams (1955) found the red-backed vole to be abundant in lodgepole pine forests in central Colorado and Brown (1967) reported this species to be very numerous in spruce-fir forests, common in lodgepole pine and present, but in fewer numbers, in aspen in southeastern Wyoming. However, in the Piceance Basin, the red-backed vole was encountered more frequently in aspen (Table 3-7-72) but indicated definite affinities for both aspen and Douglas-fir (Table 3-7-73).

The trapping results for the red-backed vole are presented in Tables 3-7-159 to 3-7-163. Lechleitner (1969) reported that this species, like all the vole species encountered during trapping, can be seen during the day or night, but is most active at night. It is also active throughout the winter.

Jolly-Seber population estimates and estimates of average trap range on grids F (Douglas-fir) and G (aspen) are presented in Tables 3-7-164 to 3-7-168. The paucity of data, however, precludes formulation of definite conclusions concerning absolute densities and home ranges for this species at this time.

Average weights are provided in Tables 3-7-169 to 3-7-171. Along with the sagebrush vole, the red-backed vole is the smallest of the vole species captured during trapping operations.

j) Montane Vole (Microtus montanus) - Only 5 montane voles were captured during trapping operations accounting for only 0.18% of the total small mammal abundance. Although the species was captured in 3 different habitat types (Table 3-7-72) the majority of the captures occurred on grid 1 (bottomland meadow) and it showed a definite affinity for this type (Table 3-7-73). Williams (1955) captured montane voles in stream bottom and grazed meadow communities in central Colorado. Brown (1967) likewise found this vole to be common in grassy meadow situations in southeastern Wyoming.

The trapping results for the montane vole are shown in Tables 3-7-172 to 3-7-175. It was captured during all sampling periods except number 5, September-October, 1975.

Average weights for the montane vole are presented in Tables 3-7- 176 to 3-7- 177. The montane vole is the largest of the four voles captured to date during trapping operations.

k) Long-tailed Vole (Microtus longicaudus) - The long-tailed vole was the second most frequently captured vole species accounting for 1.35% of the total small mammal abundance. The species was captured in five

different habitat types but was most often caught on grid A (greasewood-sagebrush) (Table 3-7-72), and shows a definite affinity for this habitat type (Table 3-7-73). The long-tailed vole inhabits a variety of habitat types in Colorado, from wet meadow to dry rocky slopes (Warren, 1942) and has a wide altitudinal range, from below 5,000 ft elevation to above timberline in western Colorado (Armstrong, 1972). Armstrong (1972), however, reported that this vole is most abundant in streamside meadows with a thick ground cover. Durrant and Robinson (1962) found this species to be common in brushy meadows with a sparse herbaceous stratum in southwestern Colorado, suggesting that the long-tailed vole is not as dependent on dense ground cover as is the montane vole. Brown (1967) found the long-tailed vole to be common in meadow and bog situations and in aspen forests but absent from sagebrush and mountain mahogany communities in southeastern Wyoming.

The trapping results for the long-tailed vole are shown in Tables 3-7-178 to 3-7-182. This species was represented in samples from every trapping period. Average weights are presented in Tables 3-7-183 to 3-7-185. This vole is larger than the red-tailed and sagebrush vole. but slightly smaller than the montane vole.

Food preferences for the long-tailed vole captured during removal trapping operations in aspen are presented in Table 3-7-186. As indicated by the data, the long-tailed voles are primarily herbaceous feeders and take advantage of succulent foods almost exclusively when available (Rieve, 1973). During May, when succulent foods were scarce at high elevations, and late summer, the long-tailed voles utilized seeds to a greater extent.

The reproductive status of female long-tailed voles collected during May, July, and October, 1975 from the aspen vegetation type are shown in Table 3-7-113. Peak reproductive activity for voles inhabiting aspen communities appeared to occur during July as none of the females examined in May were active, all were active in July and 50% were active in October. Female long-tailed voles, like most of the rodents in the study area, are polyestrous (capable of more than one litter in a season). Average litter size appears to be about 4.5 (Table 3-7-114). This is consistent with litter sizes reported for the long-tailed voles by Lechleitner (1969).

l) Sagebrush Vole (*Lagurus curtatus*) - Only 22 sagebrush voles were captured during live trapping operations which accounted for 0.80% of the total small mammal captures. The species was trapped most often on grid D (sagebrush) and grid E (mixed brush) (Table 3-7-72) and showed a definite affinity for both of these habitat types (Table 3-7-73). It was also captured on grid 1 (bottomland meadow) during October and December, 1974. Sagebrush voles are usually associated with arid situations in Colorado (Lechleitner, 1969) and are generally limited to stands of sagebrush mixed with other shrubs up to 9,000 ft elevation in Rio Blanco County (Armstrong, 1972). Larrison and Johnson (1973) found the sagebrush vole to be present in small numbers only in sagebrush and crested wheatgrass communities in Idaho.

The trapping results for this species during each sampling period are shown in Tables 3-7-187 to 3-7-191. As are all the vole species encountered during trapping, the sagebrush vole is active throughout the year.

Average weights are reported in Tables 3-7-192 to 3-7-194. The sagebrush vole was one of the smallest of the vole species captured during trapping operations.

m) Apache Pocket Mouse (*Perognathus apache*) - The apache pocket mouse was one of the less commonly trapped small mammal species during trapping operations and accounted for only 0.44% of the total captures. Although this nocturnal species was captured at five different grids (Table 3-7-72), it was caught more frequently on two pinyon-juniper sites, grid 6 (pinyon-juniper/sagebrush) and grid B (pinyon-juniper/south slope), and showed an affinity for both of these types (Table 3-7-73). Armstrong (1972) reported that the apache pocket mouse generally inhabits sandy sites where burrows are constructed beneath low brush or cactus. Douglas (1969) captured this species in a burned-off pinyon-juniper woodland in Colorado.

The trapping results for the apache pocket mouse are reported in Tables 3-7-195 to 3-7-197. Although the species was not represented in December, 1974 samples (nor October, 1974 samples), Lechleitner (1969) reports that the species does not hibernate.

Average weights are presented in Tables 3-7-198 to 3-7-200. Except for the masked shrew, the apache pocket mouse was the smallest small mammal species captured during live trapping operations.

3) Seasonal Variations in Small Mammal Abundance - The seasonal changes that occur in the abundance of small mammal populations in the vicinity of Tract C-a are best illustrated by the data presented in Table 3-7-71. The highest trapping success occurred during sample period 1, October, 1974, when an average of 15.39 individuals/100 trap nights was recorded. Small mammal populations are generally at their peak levels in late summer following the breeding period. This was evidenced by a high trapping success during October for most of the species, the notable exception being the golden-mantled ground squirrel and the thirteen-lined ground squirrel. However, these species are true hibernators (Lechleitner, 1969) and had probably entered a state of reduced activity corresponding with the onset of cooler days and longer nights. Although not true hibernators, the least and Colorado chipmunks may stay in their burrows for extended periods during cold weather, sometimes in a torpid state. During this time, they may utilize stored foods gathered during more favorable times thus eliminating the need to forage during winter (Lechleitner, 1969). Due to the absence of these ground squirrel and chipmunk species, trapping success (5.37 individuals/100 trap nights) was greatly reduced during the December, 1974 sampling period.

Although all species were represented in the May, 1975 samples, total abundance (12.71 individuals/100 trap nights) as indicated by trapping success was reduced from October, 1974 samples. Most small mammal populations existing in cooler climates are undoubtedly somewhat reduced by overwinter mortality. The extent of the overwinter mortality is indicated by the Jolly-Seber parameter O, the probability an animal alive at time i survives to time i+1, estimated for those species on the larger grids with sufficient recapture data. In almost all instances, this parameter was the lowest for trap night 5, indicating low probability of survival from October, 1974 to May, 1975. Also, although some small mammals may have been at their height of reproductivity

during late May, recruitment of juveniles into the active foraging population did not occur until later in the summer. This is evidenced by the trapping results provided for each species as juveniles of three species only, deer mouse, golden-mantled ground squirrel, and apache pocket mouse, were captured during May. Thus, the effects of overwinter mortality coupled with the absence of newly recruited juveniles were probably the main reasons for the reduced small mammals' population levels indicated in May.

As indicated by the reproductive status for female least chipmunks, deer mice, and long-tailed voles, most small mammal species were probably near their height of reproductive activity during July. Correspondingly, juveniles of practically all species were caught in July grid samples. Therefore, an increase in trapping success would be expected in July not a decrease as indicated by the data (11.37 individuals/100 trap nights in July versus 12.71 in May).

However, in this instance trapping success was probably not a good indication of total small mammal population levels. During July, productivity is high and food is abundant. Therefore, baiting materials were probably not as attractive to small mammals as during other periods when food was not as plentiful. The result was a decrease in number of animals attracted to the traps and a corresponding decrease in trapping success.

By October, most of the species were finished or nearly finished reproducing and many new juveniles were present in trapping samples. Natural foods were less abundant than in July and most small mammals were probably again attracted to peanut butter, oats, and cracked corn. The result, as expected, was an increase in trapping success (14.52 individuals/100 trap nights). In fact, small mammal population levels in October, 1975, as indicated by trapping success, were comparable to the levels found during October, 1974 sampling.

b. <u>Pitfall Trapping</u>- To insure that all small mammal species present in the vicinity of Tract C-a were inventoried, pitfall traps were established in all major vegetation types. These traps are designed to capture live-trap shy small mammals, or those not attracted to the peanut butter-oats-cracked

corn bait used in live trapping. The results of the pitfall trapping program are presented in Table 3-7-201.

To date, only one small mammal species not documented by live trapping methods has been captured in pitfall traps. The masked shrew (Sorex cinereus) was captured in greasewood-sagebrush (pitfall A) during October and December, 1974 and in sagebrush (pitfall D) during October, 1974. However, one vole and two shrews were caught during October, 1975 pitfall trapping operation, which had not been positively identified. This is presently being done by Dr. Robert B. Finley, a mammalogist with the National Fish and Wildlife Laboratory.

The northern pocket gopher has been captured both in pitfall traps (May, 1975) and live traps (May and July, 1975) on the bottomland meadow grid. This gopher, as other pocket gophers, is highly specialized for a fossorial life and spends the majority of its time underground (Lechleitner, 1969). This species has the broadest geographic and altitudinal range of Coloradoan pocket gophers. It also has the broadest ecological tolerance, occurring in greatest numbers on deep sandy soils, but colonizing heavy clays and coarse, gravelly soils as well (Armstrong, 1972).

The masked shrew is the second shrew species that has been documented to date in the study area. The other species, Merriam's shrew, was captured in a live trap on grid D (sagebrush) during October, 1974. Shrews are highly insectivorous (Lechleitner, 1969) which may account for the low incidence of captures in live traps.

Although all specimens of the masked shrew were taken in well-drained, predominately sagebrush stands, both Armstrong (1972) and Lechleitner (1969) reported that this species is most commonly found in moist habitats within coniferous forests. It is expected therefore that the as yet unidentified shrew taken from the pitfall established in aspen vegetation will also be a masked shrew.

c. Night Spotlight Census - The night spotlight census was conducted on the nights of November 11 and 13, 1974, February 10 and 12, June 22 and 25, and October 19, 1975. Only one night of the spotlight census was performed

Table 3-7-201 Summary of pitfall trapping results for each sampling location during each sampling period to date for RBOSP

Sampling Location*	Vegetation Type	Sampling Period				
		October, 1974	December, 1974	May, 1975	July, 1975	October, 1975
1	Bottomland Meadow	**	**	2 Montane voles; 1 Northern pocket gophers	--	--
2	Sagebrush	**	**	1 apache pocket mouse	1 deer mouse	
3	Rabbitbrush	**	**		2 apache pocket mice	
4	Pinyon-juniper/mixed brush	**	**		2 deer mice 1 apache pocket mouse	1 vole***
6	Pinyon-juniper/sagebrush	**	**		--	--
7	Upland Meadow	**	**	1 apache pocket mouse	--	3 deer mice 1 shrew ***
A	Greasewood/sagebrush	1 masked shrew	2 masked shrews	--	--	1 sagebrush vole
B	Pinyon-juniper (south slope)	--	--	--	--	1 deer mouse
C	Pinyon-juniper (north slope)	--	--	--	--	--
D	Sagebrush	1 masked shrew	--	1 apache pocket mouse	2 deer mice	--
E	Mixed Brush	**	**	--	1 long-tailed vole	1 sagebrush vole
F	Douglas - fir	**	**	--	--	--
G	Aspen	**	**	**	--	1 shrew***
H	Riparian	--	--	--	--	--

* Except for H(Riparian) sampling locations are established in the same types as small mammal live trapping grids.
** Pitfall traps not established.
*** Positive species identifications are presently being confirmed by Dr. Robert B. Finley, a mammologist with the National Fish and Wildlife Laboratory.

during October, 1975 because of unfavorable weather conditions and the onset of mule-deer hunting season.

This method of censusing nocturnally-active animals, especially lagomorphs, has proven valuable in short-grass plains situations but encounters problems of visibility in the Piceance Basin due to the dense vegetation and varied terrain. A modification of the standard method, as applied by ECI, helps to account for this lack of visibility. The results of all census periods are presented in Table 3-7- 202.

The presence of at least three species of lagomorphs have been documented to date on or near Tract C-a. The white-tailed jackrabbit (Lepus townsendii) and the black-tailed jackrabbit (L. californicus) were easily identified by field observation, but the cottontail (Sylvilagus sp.) is much more difficult to distinguish to species. A specimen was collected by ECI personnel and identified by Dr. Robert B. Finley of the National Fish and Wildlife Laboratory as a Nuttall's cottontail (Sylvilagus nuttallii). However, it is possible that more than one species of cottontail resides in the study area. Two lagomorph species (cottontail and white-tailed jackrabbit) and the porcupine (Erethizon dorsatum) were observed during night spotlight censuses conducted thus far.

The white-tailed jackrabbit occurs on the plains and in open areas within the Colorado mountains where it feeds primarily on herbaceous material during spring, summer, and fall, but consumes more shrubs during the winter (Lechleitner, 1969). It has been observed on the Tract C-a study area in the upland sage vegetation type of the 84 Mesa and among sparse sage or on open grassy areas of the Cathedral Bluffs. The black-tailed jackrabbit has been observed, and a specimen taken, on the mowed hay field near the 84 ranch. This jackrabbit is smaller than the white-tailed jackrabbit and characterized by a black dorsal stripe extending from the tail onto the rump; its winter pelage is never white as in the case of the white-tailed jackrabbit (Lechleitner, 1969).

Nuttall's cottontail or the mountain cottontail is the only cottontail species identified from specimens taken to date. It inhabits edge situations at

Table 3-7- 202 Results of the night spotlight censuses conducted November 11 and 13, 1974, February 10 and 12, June 22 and 25 and October 19, 1975 for RBOSP

Species	Number Sighted	Hectares Covered	Pop. Est./ Hectare
	November, 1974		
Cottontail (Sylvilagus sp.)	3	136.7	0.02
White-tailed jackrabbit (Lepus townsendii)	1	136.7	0.01
	February, 1975		
There were no animals observed during this night census period.			
	June, 1975		
Cottontail (Sylvilagus sp.)	4	120.4	0.03
White-tailed jackrabbit (Lepus townsendii)	4	120.4	0.03
Porcupine (Erethizon dorsatum)	2	120.4	0.02
	October, 1975		
There were no animals observed during this night census period.			

elevations ranging from 6,000 to 11,000 ft and feeds on a variety of grasses, sedges, forbs, and shrubs (Armstrong, 1972); Lechleitner, 1969). The desert cottontail, which also may be present in the Tract C-a area, characteristically occurs at elevations below 7,000 feet and may cohabit the mountain valleys of western Colorado with Nuttall's cottontail (Lechleitner, 1969).

Lagomorph population estimates and general field observations indicate that current lagomorph populations are low. Data gathered by Colorado Division of Wildlife personnel across western Colorado support this finding and show that lagomorph populations reached their cyclic low during 1974 after having reached a high plateau during 1970. Populations are expected to increase during the next few years (Claud White, Regional Game Management Biologist for the Colorado Division of Wildlife, personal communication, 1975).

The porcupine (Erethizon dorsatum) is a large, stout-bodied rodent, semi-arboreal in habit, which feeds primarily on the leaves, bark, buds, and twigs of both deciduous and coniferous trees. They sometimes eat forbs and grasses as well (Lechleitner, 1969). Trees stripped of bark provide evidence of the presence of porcupine in many of the pinyon stands in the Tract C-a study area.

d. Bat Investigations - Mist netting for bats took place on four consecutive nights in June and on four consecutive nights in August, 1975. One or two nets were operated each night and over both periods a total of 4 locations were sampled. At 3 of these locations, the nets were placed over stock tanks and at the fourth location, the net was placed over a small shallow pond. Five bat species have been captured to date.

In June, the long-eared myotis (Myotis evotis) and the small-footed myotis (M. leibii) were captured at two stock tanks in bottomland sagebrush habitats. The small-footed myotis is known to occur in a variety of situations throughout the state and to over-winter in Colorado as well (Armstrong, 1972). The long-eared myotis occurs in sparse coniferous forests and semiarid shrublands in western Colorado, and migrates out of the state in winter (Armstrong, 1972).

In August, 4 bat species were captured in one of the same bottomland sagebrush locations sampled in June. In addition to the two above-mentioned bats, the California myotis (Myotis californicus) and the big brown bat (Eptesicus fuscus) were netted over this stock tank in August. The California myotis is a species of western North America and occurs only in western-most Colorado at lower elevations (Armstrong, 1972). The big brown bat is one of the most common bats in Colorado as well as in the United States. This species is well adapted to human inhabitation, roosting most often in man-made structures; and, like the small-footed myotis, the big brown bat over-winters in the state (Lechleitner, 1969).

Also during August sampling, a hoary bat (Lasiurus cinereus) and a small-footed bat were captured at a small pond located near a dense stand of rabbitbrush below the Stake Springs impoundment. The hoary bat is much larger than any of the Myotis species and occurs statewide at lower and middle elevations, but nowhere appears abundant (Lechleitner, 1969).

Large, solitary bats have been observed in flight on Cathedral Bluffs (elevations up to 8,500 ft) during mammal night spotlight censuses. However, our attempt to mist net any of these bats over a stock tank near the top of the bluffs in August was unsuccessful. Dr. Robert B. Finley of the National Fish and Wildlife Service (personal communication) has been mist netting bats in the area and suspects from his captures north and east of Tract C-a that the hoary bat would occur predominantly at the higher elevations of the study area near coniferous forests. The silver haired bat (Lasionycteris noctivagans) and the big brown bat may also appear at these higher elevations on Cathedral Bluffs.

4. Discussion - The presence of 28 species of small (and medium-sized) mammals has been documented by live, removal, and pitfall trapping, night spotlight censusing, mist netting (for bats) and opportunistic observations in the vicinity of Tract C-a (Table 3-7-64). Data collected during live-trapping operations from over 2700 individuals, comprising 13 small mammal species, have permitted the formulation of several generalizations concerning the distribution and abundance of small mammal populations among major habitats

within the area of investigation. Although these generalizations were drawn from live-trapping data the generalizations are not necessarily restricted to live-trappable small mammals but are probably applicable to all small (and medium-sized) mammals encountered except, of course, bats.

Small mammals ultimately depend upon vegetation for food, shelter, and in some cases as their only supply of water. Consequently, vegetation, specifically the amount and kind of vegetation, is the most important factor controlling the distribution and abundance of small mammal populations in the vicinity of Tract C-a. Elevation appears to be important also, especially for some species.

Within habitats sampled below 8000 ft elevation, the amount of shrub cover appears to be the most important factor regulating the abundance of small mammals. The largest number of small mammals captured per unit trapping effort (i.e., individuals/100 traps) occurred on grid 3 (rabbitbrush), followed in order by grid A (greasewood-sagebrush) and grid 5 (mixed brush) (Table 3-7-71). Vegetation data collected from permanent phytosociological transects on or near small mammal grids showed that these grids also exhibited the highest shrub cover of all grids below 8000 ft (Table 3-7-74). Accordingly, the grid with the fewest captures below 8000 ft, grid 1 (bottomland meadow), also exhibited the lowest shrub cover.

Although the same trend holds true for grids above 8000 ft, i.e., more small mammals are encountered in habitats with a higher shrub cover, total small mammal abundance is lower for these grids than for those at lower elevations. This is undoubtedly due to the harsher conditions and shorter growing season at the higher elevation.

Species diversity, as indicated by the Shannon-Weiner index which accounts for both number of species and number of individuals of each species, seems to be tied closely to the presence or absence of trees (i.e., pinyon-juniper) in habitats below 8000 ft. Of the larger (7.29 ha) grids, the two that consistently showed the highest diversity were the two established within pinyon-juniper woodlands, grid B (pinyon-juniper/south slope) and grid C (pinyon-juniper/

north slope). Likewise, grid 4 (pinyon-juniper/mixed brush) had the highest species diversity for the 0.81 ha grids. Pinyon and juniper trees provide food for many small mammal species that eat the highly nutritious pinyon nuts and juniper berries. The latter are more consistently available than pinyon nuts as they remain on trees a large part of the year and are not so completely destroyed by insects as pinyon nuts (Frischknecht, 1975). The cambium of pinyon may also be eaten by certain species and the shreddy bark of juniper is often used in nest building (Frischknecht, 1975).

The value of pinyon and juniper trees as a source of food and potential nesting sites is further emphasized when it is noted that eight of the 13 species encountered during all live-trapping operations inhabited pinyon-juniper woodlands. In fact, three of the species, piñon mouse, Colorado chipmunk, and the bushy-tailed woodrat, were generally limited to this vegetation type. Another species, the golden-mantled ground squirrel, was caught almost exclusively on grids established within or adjacent to pinyon-juniper woodlands (Table 3-7-72).

At elevations above 8000 ft the harshness of the environment--not the presence or absence of trees--is probably the primary determining factor in the distribution of small mammals. Of the 13 species encountered, only 5 were captured in grids established at the higher elevations. Furthermore, only one trappable small mammal species, the red-backed vole, is adapted to the environmental extremes of the higher altitudes (Lechleitner, 1969).

The two most abundant small mammal species within the vicinity of Tract C-a are the least chipmunk and the deer mouse. Both were represented in samples from every grid and together accounted for 82.45% of the total small mammal abundance. The habitat affinities of the least chipmunk and the deer mouse, as indicated by chi-square values (Table 3-7-73), were almost identical as both species were caught more frequently in habitat types with a high shrub cover.

The golden-mantled ground squirrel, though not nearly as abundant as either the least chipmunk or the deer mouse, was the third most frequently captured

small mammal, accounting for 5.41% of the total abundance. This species indicated a definite affinity for pinyon-juniper woodlands as did three other species, the Colorado chipmunk, piñon mouse, and the bushy-tailed woodrat, discussed previously.

The other seven trappable small mammal species were captured rather infrequently and accounted for only 6.87% of the total abundance. However, some species were predominant in certain habitat types and a definite pattern of macrohabitat preferences was discernible for all.

Captures of the thirteen-lined ground squirrel were limited to the grid established in sagebrush vegetation on 84 Mesa, and accordingly, the species showed a definite affinity for this habitat. The apache pocket mouse was captured within five different types but showed an affinity for pinyon-juniper woodlands. Merriam's shrew, by virtue of its one capture in sagebrush, indicated an affinity for that type. This affinity, however, is substantiated by the literature (Armstrong, 1972).

Of the four vole species, the red-backed vole was the most abundant. It is adapted for living at elevations above 8000 ft (Lechleitner, 1969) and was the predominant small mammal in both Douglas-fir and aspen vegetation. The montane vole showed a definite affinity for bottomland meadow while its cogener, the long-tailed vole, indicated an affinity for the thick greasewood-sagebrush-rabbitbrush stands characteristic of the bottomland drainages. The sagebrush vole, as its name implies, revealed a preference for sagebrush as well as for mixed brush.

Of the three species collected by removal trapping for analyses of stomach contents, two, the least chipmunk and the deer mouse, indicated preferences for seeds. However, both utilized succulent materials more frequently in the spring when new seeds were not yet abundant. The deer mouse was slightly more omnivorous in its food habits as invertebrates and vertebrate materials were occasionally observed in stomach contents. Long-tailed voles, collected within the aspen vegetation type, utilized primarily succulent materials. However, it too was opportunistic when its favored food was not available, since

a high percentage of seeds was found in stomachs of specimens collected in early spring.

As indicated by both the proportion of juveniles in samples taken from each trapping period and reproductive data collected from least chipmunk, deer mouse, and long-tailed vole specimens, the peak of the reproductive activity for most of the small mammal species encountered appears to occur from May to July. Correspondingly, small mammal population levels are at their highest in late summer after the breeding season. Overwinter mortality results in population lows during early spring.

Several species of small and medium sized mammals not amenable to inventory by the live-trapping techniques employed where documented by other methods. Pitfall traps, established in all major habitats, revealed the presence of the masked shrew.

A cottontail and two species of jackrabbits, the white-tailed jackrabbit and the black-tailed jackrabbit, as well as the porcupine, were seen during night spotlight censuses. The censuses confirmed information obtained from the Colorado Division of Wildlife that lagomorph population levels in the Piceance Basin are low.

The presence of two species of bats, the long-eared myotis and the small-footed myotis, were revealed by mist netting during June, 1975. Two more species, the California myotis and the hoary bat, were documented during August sampling.

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Figures and Tables for the

Small Mammals Section

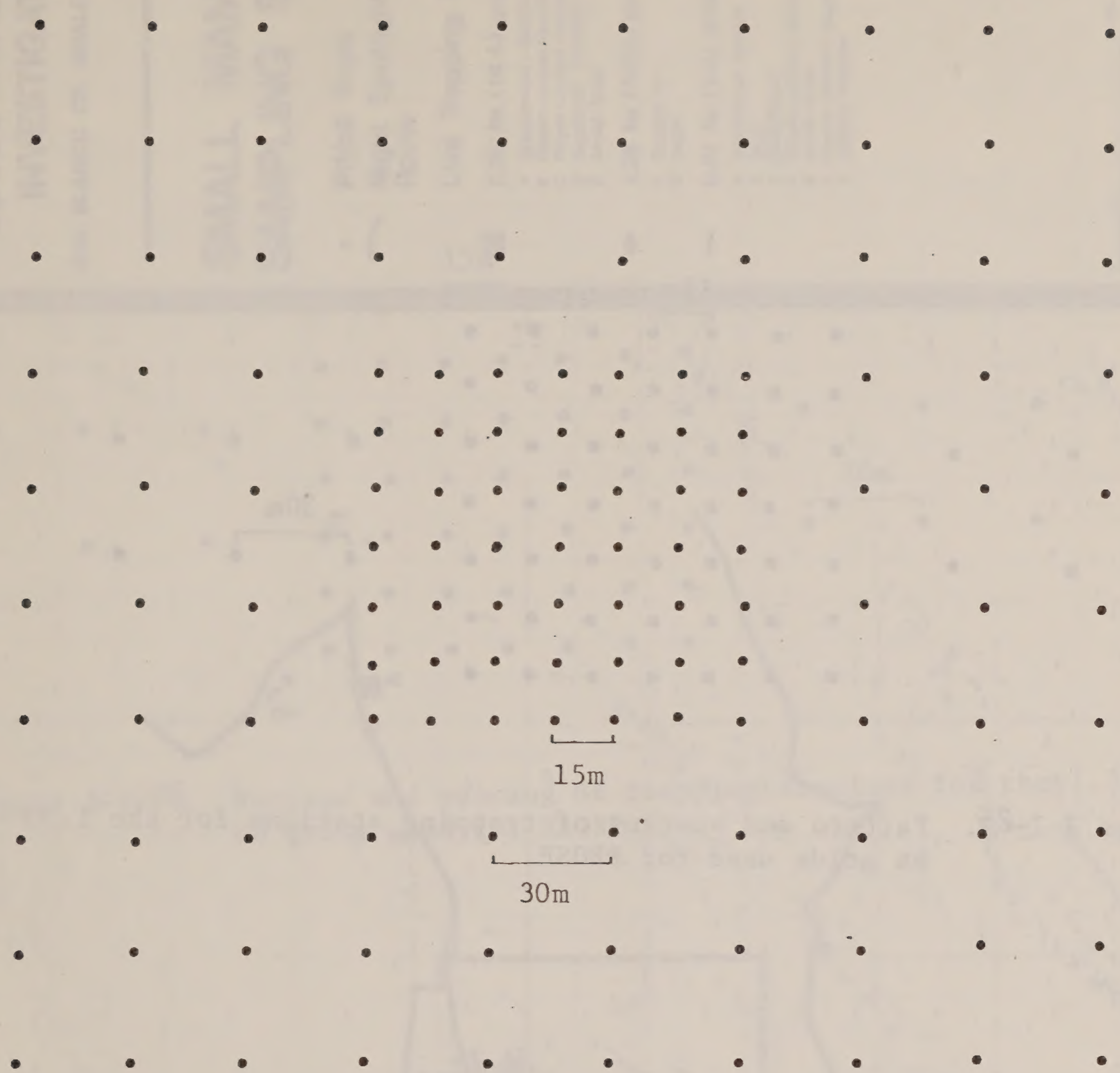

Figure 3-7-24 Pattern and spacing of trapping stations for the 7.29 ha grids used for RBOSP.

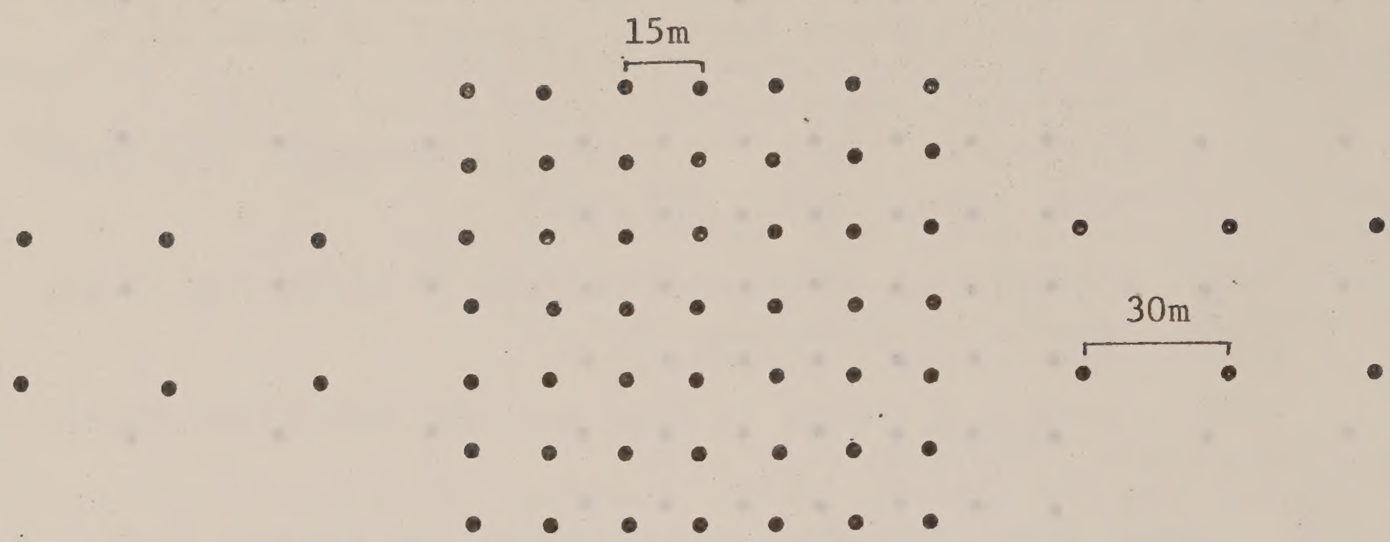

Figure 3-7-26. Pattern and spacing of trapping stations for the 1.35 ha grids used for RBOSP.

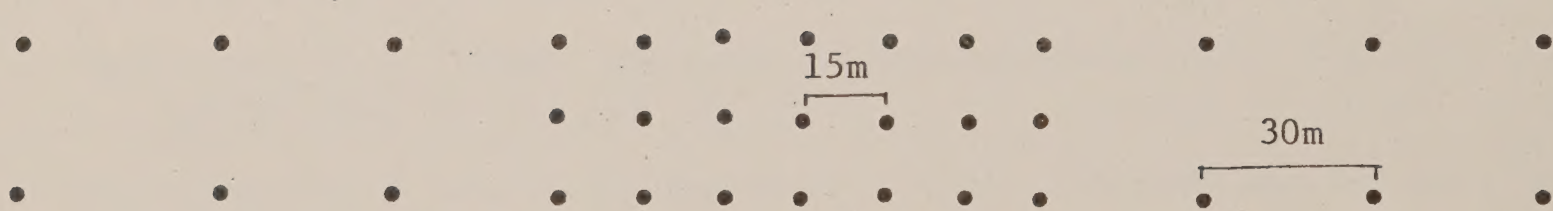

Figure 3-7-25 Pattern and spacing of trapping stations for the 0.81 ha grids used for RBOSP.

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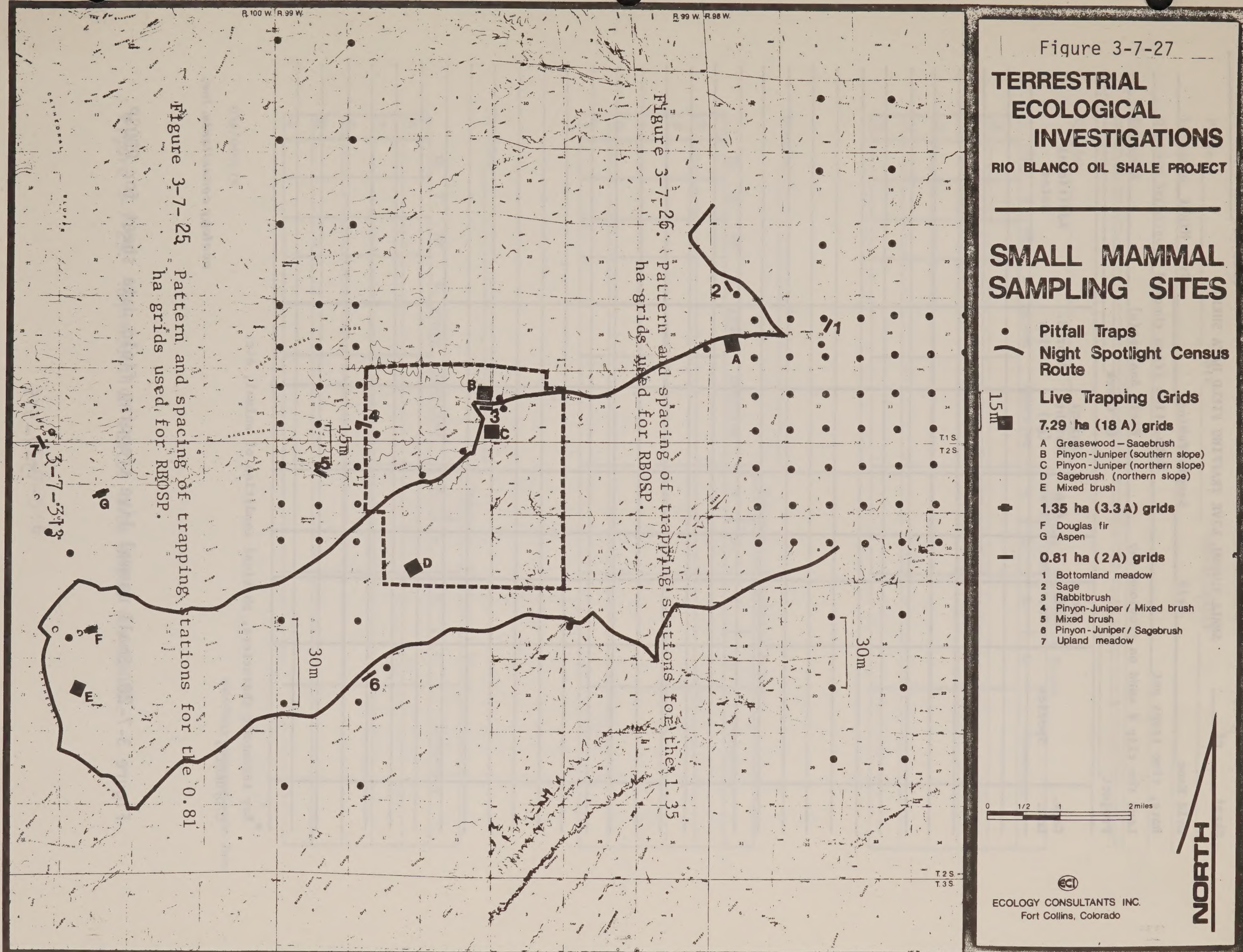
Figure 3-7-27
TERRESTRIAL ECOLOGICAL INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
SMALL MAMMAL SAMPLING SITES
Pitfall Traps
Night Spotlight Census Route
Live Trapping Grids
7.29 ha (18 A) grids
A Greasewood – Sagebrush
B Pinyon-Juniper (southern slope)
C Pinyon-Juniper (northern slope)
D Sagebrush (northern slope)
E Mixed brush
1.35 ha (3.3 A) grids
F Douglas fir
G Aspen
0.81 ha (2 A) grids
1 Bottomland meadow
2 Sage
3 Rabbitbrush
4 Pinyon-Juniper / Mixed brush
5 Mixed brush
6 Pinyon-Juniper / Sagebrush
7 Upland meadow
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R.100 W. R.99 W.
R.99 W. R.98 W.
T.1 S.
T.2 S.
T.3 S.

050/060175

File No: ____________________

Sheet ____ of ____: SMALL MAMMAL LIVE TRAPPING FIELD DATA SHEET

Grid Name________________ Grid________ Sample Period____________ Trap Night____________

Date, time traps set________________________ Date, time traps checked________________________

Last toe clip # used on previous day__________ Field Analyst(s)________________________

Project________________ QA Check________________________

Capt. Loc.	Species	Toe Clip No.	Sex	Age Class	Animal Weight (gm)	Reprod. Status	Additional Notes*

*Key taxonomic characters, physical condition of animal, etc.

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Figure 3-7-28. Small mammal live trapping field data sheet for RBOSP.

REPRODUCTIVE STATUS DATA SHEET

Project________________ Date______________ Investigator____________________

Location_______________________ Habitat_______________________________

Capture Technique____

Comments____

Species______________________________

	TL	T	HF	E	grams	Inactive	Embryos R	Embryos L	Placental Scars R	Placental Scars L	Comments
A											
B											
C											
D											
E											

Species______________________________

	TL	T	HF	E	grams	Inactive	Embryos R	Embryos L	Placental Scars R	Placental Scars L	Comments
A											
B											
C											
D											
E											

Species______________________________

	TL	T	HF	E	grams	Inactive	Embryos R	Embryos L	Placental Scars R	Placental Scars L	Comments
A											
B											
C											
D											
E											

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Figure 3-7-29. Reproductive status data sheet for RBOSP.

STOMACH ANALYSIS DATA SHEET

Project_________________ Date_____________ Investigator____________________________

Location_______________________________ Habitat_________________________________

Capture Technique____

Comments____

Species_______________________________

	A	B	C	D	E		A	B	C	D	E		A	B	C	D	E		A	B	C	D	E		A	B	C	D	E
1						11						21						31						41					
2						12						22						32						42					
3						13						23						33						43					
4						14						24						34						44					
5						15						25						35						45					
6						16						26						36						46					
7						17						27						37						47					
8						18						28						38						48					
9						19						29						39						49					
10						20						30						40						50					

Measurements						
	Sex	TL	T	HF	E	grams
A						
B						
C						
D						
E						

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Figure 3-7-30 Stomach analysis data sheet for RBOSP.

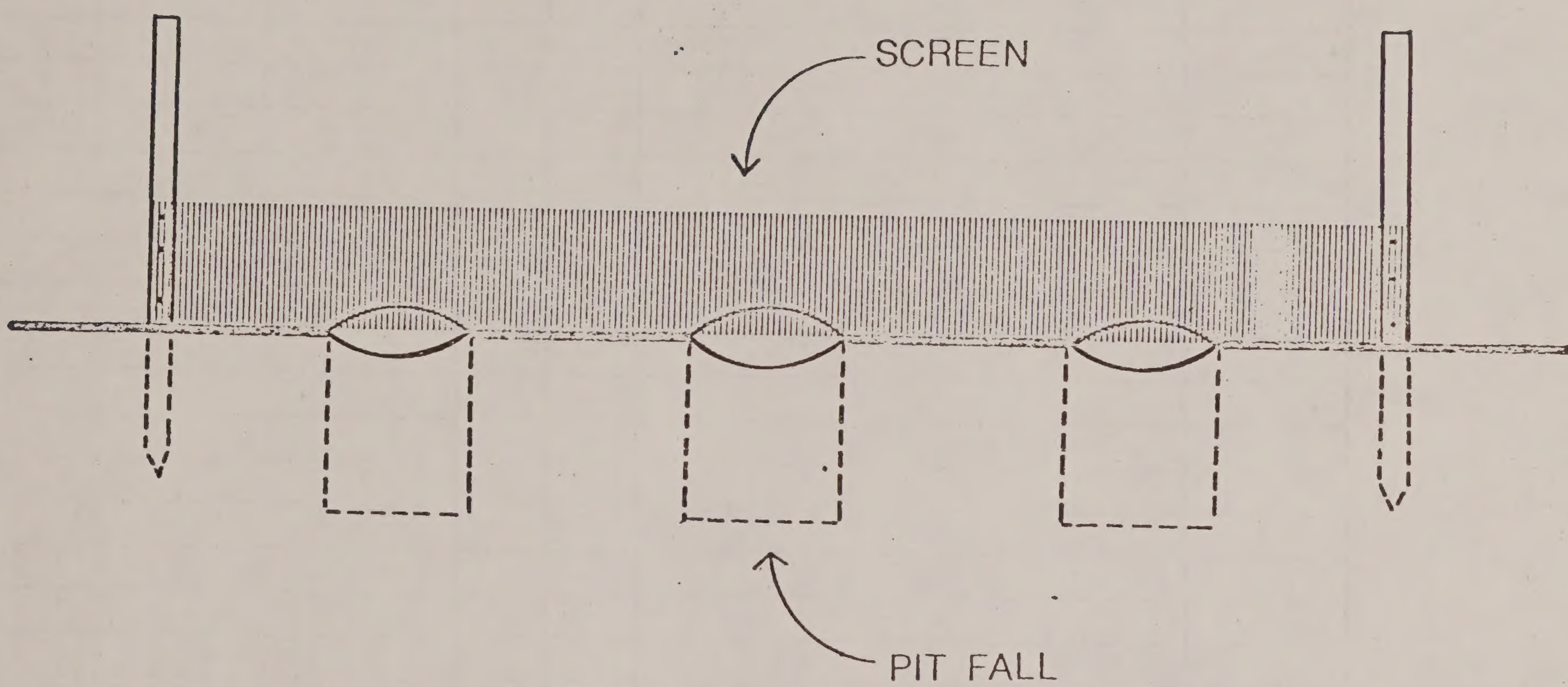

Figure 3-7-31 Typical pitfall can and drift fence arrangement used to capture trap-shy mammals for RBOSP.

File No:__________________

SMALL MAMMAL PITFALL FIELD DATA SHEET

Pitfall Number ________ Location____________________ Field Analysts________________________

Sampling Period__________ Project Number________ QA Check____________________________

Date	Species	Sex	Age	Comments*

*Reproductive condition, diagnostic characters, future use of specimens, etc.

057/060175

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Figure 3-7-32. Small mammal pitfall field data sheet for RBOSP.

Figure 3-7-33. Night spotlight transect route for RBOSP

Figure 3-7-33 sent to Limnetics, Inc.

MAMMAL NIGHT ROAD CENSUS DATA AND SUMMARY SHEET

Project__________ Transect #__________ Date__________________ Sunset Time____________

Time Begun________ Temp.________ Time Completed__________ Temp.______ Cloud Cover______%

Starting Point______________ Finish Point______________ Length of Transect____________

Observable Distance Estimates up to 25 meters.

Mile 1_____; 2_____; 3_____; 4_____; 5_____; 6_____; 7_____; 8_____; 9_____; 10_____;

11_____; 12_____; 13_____; 14_____; 15_____; 16_____; 17_____; 18_____; 19_____; 20_____;

21_____; 22_____; 23_____; 24_____; 25_____; 26_____; 27_____; 28_____; 29_____; 30_____.

Odometer Reading	Species Observed	Habitat	Odometer Reading	Species Observed	Habitat

Figure 3-7-34. Mammal night road census data sheet for RBOSP.

File No.____________________

BAT MIST NET SAMPLING SHEET

Collector(s)________________________________ Date__________________ Project______________

Location: T______ R______ S______ 1/4 1/4 S______ Time Net Set ____________________

Description ____ QA Check__________

Time Net Checked	Species	Sex	Comments (condition, collection, release, etc.)

063/060175

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Figure 3-7-35. Bat mist net sampling sheet for RBOSP.

Table 3-7-62 Site descriptions for small mammal, avifauna and invertebrate sampling locations for RBOSP.

LOCATION DESIGNATION				
Small Mammals	Avifauna	Invertebrates	Vegetation Type	Aspect/Elevation
1	1		Bottomland meadow	Flat/6300'
2	2		Sagebrush	Flat/6500'
3	3		Rabbitbrush	Flat/6800'
4	4		Pinyon-juniper/mixed brush	North/7400'
5	5	5	Mixed brush	North/7200'
6	6		Pinyon-juniper/sagebrush	Flat/7400'
7	7		Upland meadow *	Flat/8500'
A	8	1	Greasewood/sagebrush	Flat/6400'
B	9	2	Pinyon-juniper	South/7000'
C	10	3	Pinyon-juniper	North/6900'
D	11	4	Sagebrush	North/7100'
E	12		Mixed brush	South/8300'
F	13		Douglas fir	North/8200'
G	14		Aspen	North/8100'
	15		Riparian	Flat/6700'

* The designation "bald" was used for this type during vegetation sampling.

Table 3-7-63:. Approximate number of individuals of the three most common species being collected for laboratory analysis of reproductive effort and stomach contents within major vegetation types during each sampling period for RBOSP

Vegetation Type	Number of Individuals for Each Species 1/		
	Least Chipmunk (*Eutamias minimus*)	Deer Mouse (*Peromyscus maniculatus*)	Long-tailed Vole (*Microtus longicaudus*)
Aspen			5
Mixed brush	5	5	
Pinyon-juniper (southern slope)	5	5	
Pinyon-juniper (northern slope)	5	5	
Sagebrush	5	5	
Greasewood-Sagebrush	5	5	5
TOTAL	25	25	10

1/ These species were selected because they are among the most abundant small mammal species in the vicinity of Tract C-a and are representative of three different groups of rodents (sciurids, cricetids, and microtines).

Table 3-7- 64. Species of wild mammals encountered to date in the vicinity of Tract C-a for RBOSP.*

FAMILY Species	Common Name	4-letter Code**
SORICIDAE (Shrews)		
Sorex cinereus	Masked shrew	
Sorex merriami	Merriam's shrew	SOME
VESPERTILIONIDAE		
Myotis californicus	California myotis	
Myotis evotus	Long-eared myotis	
Myotis leibii	Small-footed myotis	
Eptesicus fucus	Big brown bat	
Lasiurus cinereus	Hoary bat	
LEPORIDAE (Hares and rabbits)		
Sylvilagus nuttallii	Nuttall's cottontail	
Lepus californicus	Black-tailed jackrabbit	
Lepus townsendii	White-tailed jackrabbit	
SCIURIDAE (Squirrels, ground squirrels, chipmunks)		
Eutamias minimus	Least chipmunk	EUMI
Eutamias quadrivittatus	Colorado chipmunk	EUQU
Spermophilus lateralis	Golden-mantled ground squirrel	SPLA
Spermophilus tridecemlineatus	Thirteen-lined ground squirrel	SPTR
Tamiasciurus hudsonicus	Red squirrel	
GEOMYIDAE (Pocket gophers)		
Thomomys talpoides	Northern pocket gopher	
HETEROMYIDAE (Pocket mice, kangaroo mice and kangaroo rats)		
Perognathus apache	Apache pocket mouse	PEAP
CRICETIDAE (New World mice and rats)		
Peromyscus maniculatus	Deer mouse	PEMA
Peromyscus truei	Pinon mouse	PETR
Neotoma cinerea	Bushy-tailed woodrat	NECI
Clethrionomys gapperi	Gapper's red-backed vole	CLGA

Table 3-7- 64 (Continued)

FAMILY Species	Common Name	4-letter Code**
CRICETIDAE (Continued)		
Microtus longicaudus	Long-tailed vole	MILO
Microtus montanus	Montane vole	MIMO
Lagurus curtatus	Sagebrush vole	LACU
ERETHIZONTIDAE (Porcupines)		
Erethizon dorsatum	Porcupine	
CANIDAE (Coyote, wolves and foxes)		
Canis latrans	Coyote	
MUSTELIDAE (Mustelids, weasels, skunks)		
Mustela erminea	Ermine	
Mustela frenata	Long-tailed weasel	
Taxidea taxus	Badger	
FELIDAE (Cats)		
Lynx rufus	Bobcat	
EQUIDAE (Horses)***		
Equus caballus	Feral horse	
CERVIDAE (Deer and elk)****		
Cervus canadensis	Elk	
Odocoileus hemionus	Mule deer	

*The following authority is used for small mammal nomenclature:

Hall, E.R. and K.R.Kelson. 1959. The mammals of North America. Ronald Press Company, New York. 1162 pages.

**used on small mammal live trapping data sheets

***The following authority is used for feral horse nomenclature:

Blair, W.F., A.P. Blair, P. Brodkorb, F.R. Cagle and G.A. Moore. 1968. Vertebrates of the United States, second edition. McGraw-Hill Book Company. New York. 616 pages.

****The following authority is used for large mammal (except feral horse) nomemclature:

Lechleitner, R.R. 1969. Wild mammals of Colorado. Pruett Publishing Company, Boulder, Colorado. 254 pages.

Table 3-7-65. Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid Designation	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	0.349	0.321	0.024	0.693	0.503
2	Sagebrush	0.687	0.659	0.001	0.693	0.991
3	Rabbitbrush	0.745	0.720	0.008	1.099	0.678
4	Pinyon-juniper/mixed brush	0.980	0.955	0.004	1.099	0.892
5	Mixed brush	0.665	0.650	0.002	0.693	0.960
6	Pinyon-juniper/sagebrush	0.673	0.656	0.001	0.693	0.971
7	Upland meadow	0.349	0.293	0.047	0.693	0.503
A	Greasewood-sagebrush	0.950	0.944	0.001	1.099	0.865
B	Pinyon-juniper (south slope)	1.182	1.164	0.005	1.609	0.735
C	Pinyon-juniper (north slope)	1.231	1.201	0.007	1.946	0.633
D	Sagebrush	0.981	0.956	0.007	1.792	0.547
E	Mixed brush	0.857	0.830	0.011	1.386	0.618
F	Douglas fir	0.398	0.376	0.018	0.693	0.575
G	Aspen	1.028	0.989	0.011	1.386	0.742

Table 3-7-66. Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all small mammal grids during sample period 2, December 7-12, 1974, for RBOSP

Grid Designation	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	0.803	0.761	0.021	1.099	0.731
2	Sagebrush	0.000	0.000	0.000	0.000	-
3	Rabbitbrush	0.440	0.420	0.015	0.693	0.634
4	Pinyon-juniper/mixed brush	0.000	0.000	0.000	0.000	-
5	Mixed brush	0.693	0.443	0.000	0.693	1.000
6	Pinyon-juniper/sagebrush	0.000	0.000	0.000	0.000	-
7	Upland meadow	0.000	-	-	-	-
A	Greasewood-sagebrush	0.773	0.726	0.019	1.099	0.704
B	Pinyon-juniper (south slope)	0.393	0.359	0.027	0.693	0.567
C	Pinyon-juniper (north slope)	0.693	0.443	0.000	0.693	1.000
D	Sagebrush	0.000	0.000	0.000	0.000	-
E	Mixed brush	0.000	-	-	-	-
F	Douglas fir	0.271	0.233	0.034	0.693	0.391
G	Aspen	0.491	0.475	0.010	0.693	0.709

\- Insufficient data for computation

Table 3-7-67 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid Designation	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	0.908	0.817	0.033	1.099	0.826
2	Sagebrush	0.967	0.921	0.010	1.099	0.880
3	Rabbitbrush	0.894	0.877	0.004	1.099	0.814
4	Pinyon-juniper/mixed brush	1.001	0.961	0.012	1.386	0.722
5	Mixed brush	0.642	0.629	0.003	0.693	0.927
6	Pinyon-juniper/sagebrush	0.935	0.893	0.015	1.386	0.675
7	Upland meadow	0.500	0.467	0.020	0.693	0.722
A	Greasewood-sagebrush	0.849	0.837	0.003	1.099	0.773
B	Pinyon-juniper (south slope)	1.440	1.413	0.006	1.792	0.804
C	Pinyon-juniper (north slope)	1.331	1.298	0.007	1.609	0.827
D	Sagebrush	0.998	0.975	0.007	1.386	0.720
E	Mixed brush	1.046	1.023	0.009	1.609	0.650
F	Douglas fir	0.645	0.626	0.004	0.693	0.931
G	Aspen	0.810	0.779	0.007	1.099	0.737

Table 3-7-68 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid Designation	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	0.500	0.400	0.061	0.693	0.722
2	Sagebrush	1.047	1.003	0.014	1.386	0.755
3	Rabbitbrush	0.619	0.571	0.034	1.099	0.563
4	Pinyon-juniper/mixed brush	1.038	0.992	0.006	1.099	0.945
5	Mixed brush	0.683	0.647	0.001	0.693	0.985
6	Pinyon-juniper/sagebrush	1.133	1.073	0.014	1.386	0.817
7	Upland meadow	0.520	0.484	0.020	0.693	0.750
A	Greasewood-sagebrush	1.040	1.022	0.004	1.386	0.750
B	Pinyon-juniper (south slope)	1.634	1.606	0.004	1.946	0.839
C	Pinyon-juniper (north slope)	1.477	1.452	0.004	1.792	0.825
D	Sagebrush	1.165	1.136	0.003	1.386	0.840
E	Mixed brush	1.137	1.110	0.007	1.609	0.706
F	Douglas fir	0.693	0.670	0.000	0.693	1.000
G	Aspen	0.613	0.563	0.033	1.099	0.558

Table 3-7-69 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid Designation	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	0.000	0.000	0.000	0.000	-
2	Sagebrush	0.718	0.683	0.021	1.099	0.653
3	Rabbitbrush	0.455	0.429	0.018	1.099	0.414
4	Pinyon-juniper/mixed brush	0.971	0.900	0.033	1.386	0.701
5	Mixed brush	0.655	0.646	0.001	0.693	0.946
6	Pinyon-juniper/sagebrush	0.295	0.274	0.019	0.693	0.426
7	Upland meadow	0.000	0.000	0.000	0.000	-
A	Greasewood-sagebrush	0.970	0.959	0.003	1.609	0.603
B	Pinyon-juniper (south slope)	1.296	1.265	0.009	1.946	0.666
C	Pinyon-juniper (north slope)	1.314	1.281	0.008	1.792	0.734
D	Sagebrush	0.721	0.686	0.022	1.386	0.520
E	Mixed brush	0.764	0.747	0.007	1.609	0.475
F	Douglas fir	1.147	1.091	0.011	1.386	0.827
G	Aspen	1.245	1.198	0.007	1.386	0.898

\- Insufficient data for computation

Table 3-7-75. Summary of trapping results for Spermophilus tridecemlineatus (thirteen-lined grd. sqr.) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	1.82	100.0	0.33	0.67	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-76 Summary of trapping results for *Spermophilus tridecemlineatus* (thirteen-lined grd. sqr.) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights*	Relative Abundance**	Proportion Captured: Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	3.64	100.0	0.17	0.17	0.17	0.50
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-77 = Summary of trapping results for Spermophilus tridecemlineatus (thirteen-lined grd. sqr.) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	1.82	100.0	0.33	0.67	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-78 Average live weights (gm) for adult <u>Spermophilus</u> <u>tridecemlineatus</u> (thirteen-lined grd. sqr.) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	1	59.0		2	58.0	4.0	3	58.3	2.3
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	59.0		2	58.0	4.0	3	58.3	2.3

Table 3-7-79 Average live weights (gm) for adult Spermophilus tridecemlineatus (thirteen-lined grd. sqr.) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	1	78.0		1	94.0		2	86.0	8.0
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	78.0		1	94.0		2	86.0	8.0

Table 3-7-80 Average live weights (gm) for adult Spermophilus tridecemlineatus (thirteen-lined grd. sqr.) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	1	73.0		2	63.0	6.0	3	66.3	4.8
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	73.0		2	63.0	6.0	3	66.3	4.8

Table 3-7-81 Summary of trapping results for Spermophilus lateralis (golden-mantled grd. sqr.) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.15	33.3	1.00	0.00	0.00	0.00
D	Sagebrush	0.30	66.7	1.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours

** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-82 Summary of trapping results for Spermophilus lateralis (golden-mantled grd. sqr.) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	2.42	32.8	0.25	0.25	0.50	0.00
4	Pinyon-juniper/mixed brush	0.61	8.2	1.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.61	8.2	0.00	1.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.60	8.1	0.75	0.25	0.00	0.00
B	Pinyon-juniper (south slope)	0.75	10.2	0.20	0.80	0.00	0.00
C	Pinyon-juniper (north slope)	1.05	14.2	0.43	0.57	0.00	0.00
D	Sagebrush	0.75	10.2	0.20	0.60	0.00	0.20
E	Mixed brush	0.60	8.1	1.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-83 Summary of trapping results for _Spermophilus lateralis_ (golden-mantled grd. sqr.) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	1.21	5.7	0.50	0.50	0.00	0.00
4	Pinyon-juniper/mixed brush	3.03	14.2	0.60	0.00	0.20	0.20
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	3.03	14.2	0.80	0.20	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	1.80	8.4	0.50	0.42	0.00	0.08
B	Pinyon-juniper (south slope)	3.91	18.3	0.38	0.50	0.08	0.04
C	Pinyon-juniper (north slope)	4.51	21.1	0.53	0.27	0.07	0.13
D	Sagebrush	2.56	11.9	0.41	0.59	0.00	0.00
E	Mixed brush	1.35	6.3	0.44	0.56	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-84 Summary of trapping results for Spermophilus lateralis (golden-mantled grd. sqr.) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.30	25.0	0.50	0.50	0.00	0.00
B	Pinyon-juniper (south slope)	0.15	12.5	1.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.60	50.0	0.25	0.75	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.15	12.5	1.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-85 Jolly-Seber population density estimates for *Spermophilus lateralis* (golden-mantle grd. sqr.) at grid B, pinyon-juniper (south slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	*	*	*	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*	*	*	*
4	*	*	*	*	*	*	*	*	*	*
5	*	*	*	*	*	*	*	*	*	*
6	–	–	–	–	–	–	–	–	–	–
7	–	–	–	–	–	–	–	–	–	–
8	–	–	–	–	–	–	–	–	–	–
9	–	–	–	–	–	–	–	–	–	–
10	–	–	–	–	–	–	–	–	–	–
11	0.000	*	*	*	*	*	*	*	*	*
12	*	*	*	*	*	*	*	*	*	*
13	*	*	*	*	*	*	*	*	*	*
14	0.000	*	0.0	*	*	*	*	*	*	*
15	0.333	*	*	*	*	*	*	*	0.000	*
16	0.000	*	0.0	*	*	*	*	*	1.333	0.148
17	0.000	*	1.3	*	*	*	*	*	2.000	1.167
18	0.000	*	10.7	*	*	*	53.6	*	0.750	0.188
19	0.273	0.214	14.0	51.3	4.4	1019.5	*	*	*	*
20	0.727	*	*	*	*	*	*	*	*	*
21	*	*	*	*	*	*	*	*	*	*
22	0.000	*	*	*	*	*	*	*	*	*
23	*	*	*	*	*	*	*	*	*	*
24	*	*	*	*	*	*	*	*	*	*
25	*	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

– Comparable estimates of population size are not possible for winter samples (trap nights 6–10) due to a reduction in sampling effort

Table 3-7-86 Jolly-Seber population density estimates for *Spermophilus lateralis* (golden-mantle grd. sqr.) at grid C, pinyon-juniper (north slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*	*	*	*
4	1.000	1.000	1.0	1.0	*	0.0	*	*	*	*
5	*	*	*	*	*	*	*	*	*	*
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.250	1.000	1.0	4.0	0.3	0.0	3.0	28.0	0.750	0.297
12	0.500	0.333	3.0	6.0	0.5	28.0	-1.0	7.8	0.500	0.125
13	1.000	0.500	2.0	2.0	0.2	0.0	0.0	0.0	1.000	0.000
14	1.000	1.000	2.0	2.0	0.2	0.0	2.0	0.0	0.500	0.125
15	0.333	1.000	1.0	3.0	0.3	0.0	12.0	0.0	0.333	0.074
16	0.077	1.000	1.0	13.0	1.0	0.0	23.1	436.9	1.187	0.045
17	0.400	0.259	15.4	38.6	2.9	230.9	-8.8	269.2	0.775	0.029
18	0.786	0.663	16.6	21.1	1.6	8.0	7.7	9.1	0.774	0.019
19	0.652	0.819	15.1	23.2	1.7	7.2	45.2	778.8	0.759	0.047
20	0.929	0.736	17.7	19.0	1.4	27.0	*	*	*	*
21	1.000	*	*	*	*	*	*	*	*	*
22	1.000	*	*	*	*	*	*	*	*	*
23	*	*	*	*	*	*	*	*	*	*
24	*	*	*	*	*	*	*	*	*	*
25	1.000	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-87 Definition of population parameters measured by the Jolly-Seber method and corresponding notations for RBOSP

Notation	Definition
i	Trap night 1-5 -Sample period 1, Oct. 19-24, 1974 6-10 -Sample period 2, Dec. 7-12, 1974 11-15 -Sample period 3, May 18-26, 1975 16-20 -Sample period 4, July 25-30, 1975 21-25 -Sample period 5, Sept. 31- Oct. 4, 1975
a	Proportion of marked animals in sample i
p	Probability an animal alive at time i is caught at time i
M	Estimate of the size of the marked population just before the i^{th} sample
N	Estimate of the total population size just before the i^{th} sample
#/ha	Absolute density (numbers per hectare); determined by (N x 10,000)/(effective·trapping area)
var(N(N))	Error of estimation of N
B	Number of new animals joining the population in the interval from time i to time i+1 which are still alive and in the population at time i+1
var(B)	The variance associated with estimating B
0	Probability an animal alive at time i survives to time i+1
var(0)	The variance associated with estimating 0

Table 3-7-88 Average extended range length (m) for adult *Spermophilus lateralis* (golden-mantled grd. sqr.) on small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	1	146.2		0			1	146.2	
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	146.2		0			1	146.2	

Table 3-7-89 Average extended range length (m) for adult Spermophilus lateralis (golden-mantled grd. sqr.) on small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	2	146.4	29.1	0			2	146.4	29.1
C	Pinyon-juniper (north slope)	1	230.9		1	146.2		2	188.5	42.3
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	3	174.6	32.8	1	146.2		4	167.5	29.7

Table 3-7-90 Average live weights (gm) for adult Spermophilus lateralis (golden-mantled grd. sqr.) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	1	151.0		1	177.0		2	164.0	13.0
4	Pinyon-juniper/mixed brush	1	181.0		0			1	181.0	
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			1	206.0		1	206.0	
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	2	208.5	71.5	1	266.0		3	227.7	45.5
B	Pinyon-juniper (south slope)	1	178.0		3	141.0	11.9	4	150.3	12.5
C	Pinyon-juniper (north slope)	3	160.3	7.9	4	163.8	10.2	7	162.3	6.3
D	Sagebrush	1	212.0		2	204.0	24.0	3	206.7	14.1
E	Mixed brush	1	116.0		0			1	116.0	
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	10	173.6	14.5	12	177.9	11.7	22	176.0	9.2

Table 3-7-91 Average live weights (gm) for adult *Spermophilus lateralis* (golden-mantled grd. sqr.) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	1	195.0		0			1	195.0	
4	Pinyon-juniper/mixed brush	3	163.0	8.9	0			3	163.0	8.9
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	3	165.3	18.8	1	161.0		4	164.3	13.4
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	6	161.3	11.4	5	159.8	17.0	11	160.6	9.4
B	Pinyon-juniper (south slope)	10	156.0	9.1	13	157.2	11.6	23	156.7	7.5
C	Pinyon-juniper (north slope)	16	150.1	6.0	7	142.6	5.7	23	147.8	4.5
D	Sagebrush	7	175.7	7.7	10	184.1	10.6	17	180.6	6.9
E	Mixed brush	4	169.3	12.6	5	147.0	8.2	9	156.9	7.8
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	50	160.3	3.6	41	160.4	5.4	91	160.4	3.2

Table 3-7-92 Average live weights (gm) for adult Spermophilus lateralis (golden-mantled grd. sqr.) on all small mammal grids during sample period 5, Sept. 31-Oct. 4,1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0.		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			1	148.0		1	148.0	
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	1	185.0		3	157.3	3.2	4	164.3	7.3
D	Sagebrush	0			0			0		
E	Mixed brush	1	146.0		0			1	146.0	
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	2	165.5	19.5	4	155.0	3.2	6	158.5	6.6

Table 3-7-93   Summary of trapping results for Eutamias minimus (least chipmunk) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	6.06	6.9	0.60	0.40	0.00	0.00
3	Rabbitbrush	15.15	17.3	0.24	0.76	0.00	0.00
4	Pinyon-juniper/mixed brush	9.70	11.0	0.69	0.31	0.00	0.00
5	Mixed brush	12.73	14.5	0.52	0.48	0.00	0.00
6	Pinyon-juniper/sagebrush	7.27	8.3	0.58	0.42	0.00	0.00
7	Upland meadow	0.61	0.7	1.00	0.00	0.00	0.00
A	Greasewood-sagebrush	9.62	11.0	0.55	0.45	0.00	0.00
B	Pinyon-juniper (south slope)	8.57	9.8	0.47	0.53	0.00	0.00
C	Pinyon-juniper (north slope)	4.66	5.3	0.52	0.48	0.00	0.00
D	Sagebrush	7.67	8.7	0.53	0.47	0.00	0.00
E	Mixed brush	5.71	6.5	0.50	0.50	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-94 Summary of trapping results for <u>Eutamias minimus</u> (least chipmunk) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured: Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	1.21	1.3	0.00	1.00	0.00	0.00
2	Sagebrush	7.27	7.5	0.58	0.42	0.00	0.00
3	Rabbitbrush	16.97	17.5	0.54	0.46	0.00	0.00
4	Pinyon-juniper/mixed brush	12.12	12.5	0.60	0.40	0.00	0.00
5	Mixed brush	15.15	15.7	0.48	0.52	0.00	0.00
6	Pinyon-juniper/sagebrush	6.67	6.9	0.82	0.18	0.00	0.00
7	Upland meadow	1.82	1.9	1.00	0.00	0.00	0.00
A	Greasewood-sagebrush	6.47	6.7	0.60	0.40	0.00	0.00
B	Pinyon-juniper (south slope)	5.26	5.4	0.51	0.49	0.00	0.00
C	Pinyon-juniper (north slope)	2.56	2.6	0.47	0.53	0.00	0.00
D	Sagebrush	5.41	5.6	0.56	0.44	0.00	0.00
E	Mixed brush	7.97	8.2	0.47	0.53	0.00	0.00
F	Douglas fir	2.95	3.0	0.67	0.33	0.00	0.00
G	Aspen	4.92	5.1	0.40	0.60	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-95 Summary of trapping results for <u>Eutamias minimus</u> (least chipmunk) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	12.12	21.9	0.50	0.40	0.10	0.00
3	Rabbitbrush	1.21	2.2	0.00	1.00	0.00	0.00
4	Pinyon-juniper/mixed brush	6.67	12.0	0.27	0.55	0.00	0.18
5	Mixed brush	3.64	6.6	0.17	0.50	0.17	0.17
6	Pinyon-juniper/sagebrush	3.64	6.6	0.33	0.33	0.17	0.17
7	Upland meadow	1.82	3.3	0.67	0.33	0.00	0.00
A	Greasewood-sagebrush	4.21	7.6	0.61	0.29	0.04	0.07
B	Pinyon-juniper (south slope)	5.26	9.5	0.46	0.46	0.06	0.03
C	Pinyon-juniper (north slope)	4.81	8.7	0.25	0.34	0.25	0.16
D	Sagebrush	2.26	4.1	0.47	0.47	0.00	0.07
E	Mixed brush	5.11	9.2	0.21	0.56	0.15	0.09
F	Douglas fir	3.61	6.5	0.36	0.64	0.00	0.00
G	Aspen	0.98	1.8	0.00	1.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-96 Summary of trapping results for _Eutamias minimus_ (least chipmunk) on all small mammal grids during sample period 5. Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	13.33	18.1	0.45	0.50	0.05	0.00
3	Rabbitbrush	2.42	3.3	0.25	0.75	0.00	0.00
4	Pinyon-juniper/mixed brush	1.82	2.5	0.33	0.33	0.00	0.33
5	Mixed brush	21.21	28.8	0.43	0.57	0.00	0.00
6	Pinyon-juniper/sagebrush	1.21	1.6	0.50	0.50	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	13.83	18.8	0.46	0.47	0.05	0.02
B	Pinyon-juniper (south slope)	6.47	8.8	0.58	0.37	0.02	0.02
C	Pinyon-juniper (north slope)	4.66	6.3	0.45	0.45	0.06	0.03
D	Sagebrush	0.75	1.0	0.40	0.60	0.00	0.00
E	Mixed brush	3.76	5.1	0.48	0.52	0.00	0.00
F	Douglas fir	2.62	3.6	0.63	0.38	0.00	0.00
G	Aspen	1.64	2.2	0.40	0.40	0.20	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-97 Jolly-Seber population density estimates for <u>Eutamias minimus</u> (least chipmunk) at grid A, greasewood-sagebrush, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	0.899	0.004
2	0.463	0.805	24.3	50.9	4.9	15.2	8.8	36.9	0.977	0.002
3	0.786	0.751	44.2	55.9	5.4	7.8	12.0	21.9	0.962	0.004
4	0.833	0.664	45.4	54.2	5.2	14.6	133.6	3813.6	1.289	0.083
5	0.963	0.381	68.3	70.9	6.8	273.5	12.6	16.8	0.321	0.009
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.625	0.703	21.9	34.2	3.2	11.4	2.6	22.7	0.965	0.011
12	0.706	0.426	28.8	39.9	3.7	34.6	58.0	988.9	1.154	0.053
13	0.739	0.421	40.4	54.6	5.1	140.8	2.0	48.0	0.619	0.037
14	0.778	0.280	25.0	32.1	3.0	68.2	0.2	36.6	0.914	0.073
15	0.833	0.405	24.7	29.6	2.8	49.7	*	*	0.545	0.023
16	0.000	*	14.0	*	*	*	26.5	*	1.000	0.000
17	0.667	0.353	17.0	25.5	2.3	23.4	7.2	129.3	1.111	0.015
18	0.600	0.300	20.0	33.3	3.0	71.3	18.2	959.4	0.976	0.039
19	0.429	0.146	20.5	47.8	4.3	427.6	-6.7	1296.4	1.143	0.064
20	0.583	0.250	28.0	48.0	4.3	187.7	39.1	441.0	0.767	0.027
21	0.333	0.622	25.2	72.3	6.5	136.5	-8.3	195.1	0.769	0.023
22	1.000	0.200	30.0	30.0	2.7	24.0	45.6	347.1	1.158	0.069
23	0.432	0.487	34.0	76.0	6.8	264.8	20.6	442.3	0.674	0.031
24	0.524	0.368	29.9	57.1	5.1	218.3	*	*	*	*
25	0.679	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation
\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-98 Jolly-Seber population density estimates for *Eutamias minimus* (least chipmunk) at grid B, pinyon-juniper (south slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	0.913	0.003
2	0.417	0.476	21.0	50.4	4.7	77.6	-3.2	229.8	1.049	0.001
3	0.739	0.471	36.6	48.8	4.6	24.7	7.8	37.2	0.972	0.005
4	0.800	0.680	41.4	51.4	4.8	12.6	20.4	73.2	0.976	0.013
5	0.821	0.522	44.4	53.6	5.0	40.6	1.9	16.0	0.674	0.010
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.933	0.422	33.3	35.5	3.3	7.3	4.0	15.2	1.015	0.011
12	0.929	0.387	33.8	36.2	3.3	14.0	47.0	520.3	1.014	0.027
13	0.889	0.444	36.0	40.5	3.7	38.9	-0.2	8.7	0.900	0.049
14	0.929	0.481	27.0	29.1	2.7	26.8	3.4	8.3	0.665	0.028
15	0.818	0.483	18.6	22.8	2.1	15.5	5.2	22.3	0.770	0.022
16	0.700	0.441	15.9	22.7	2.1	16.2	14.7	223.1	1.233	0.064
17	0.545	0.258	23.3	42.7	3.9	187.9	28.8	1645.9	0.822	0.051
18	0.364	0.172	23.3	63.9	5.9	688.6	7.9	10097.9	1.917	0.848
19	0.444	0.069	58.0	130.5	12.0	6029.4	30.4	13180.9	0.810	0.268
20	0.375	0.059	51.0	136.0	12.5	7608.9	-11.8	2601.6	0.490	0.053
21	0.500	0.462	27.0	51.9	4.4	120.3	31.4	623.8	0.903	0.055
22	0.632	0.327	36.8	58.2	5.0	254.2	-5.7	78.5	0.725	0.075
23	0.867	0.419	31.0	35.8	3.1	127.4	-1.4	3.5	0.500	0.072
24	1.000	0.533	15.0	15.0	1.3	35.0	*	*	*	*
25	0.800	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-99 Jolly-Seber population density estimates for <u>Eutamias minimus</u> (least chipmunk) at grid C, pinyon-juniper (north slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	0.714	0.029
2	0.300	0.600	5.0	16.7	1.4	25.9	14.1	216.4	1.128	0.007
3	0.412	0.517	13.5	32.9	2.8	60.3	-2.7	76.4	0.783	0.011
4	0.800	0.662	18.4	22.6	1.9	3.7	93.5	4214.8	1.720	0.334
5	0.765	0.317	41.0	53.6	4.6	430.6	2.7	12.3	0.260	0.013
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.700	0.612	11.4	16.3	1.6	5.9	0.5	13.2	1.094	0.042
12	0.857	0.380	15.8	18.4	1.8	17.8	-1.5	5.4	0.923	0.116
13	1.000	0.323	15.5	15.5	1.5	23.6	0.0	0.0	0.889	0.176
14	1.000	0.500	12.0	12.0	1.1	12.0	6.6	32.8	0.550	0.054
15	0.500	0.455	6.6	13.2	1.3	20.4	39.8	5157.7	0.896	0.031
16	0.167	0.233	8.6	51.6	*	889.4	-28.3	6490.2	1.130	0.031
17	0.688	0.553	19.9	28.9	*	33.4	14.2	139.6	0.683	0.030
18	0.500	0.353	17.0	34.0	*	95.3	-5.3	135.3	0.970	0.060
19	0.800	0.375	21.3	26.7	*	43.5	22.0	1202.6	3.300	9.347
20	0.700	0.091	77.0	110.0	*	10757.1	62.5	13866.2	0.250	0.068
21	0.222	0.100	20.0	90.0	8.5	5022.0	*	*	*	*
22	0.500	*	*	*	*	*	99.0	*	9.000	*
23	0.222	0.111	18.0	81.0	7.7	5184.0	*	*	*	*
24	0.667	*	*	*	*	*	*	*	*	*
25	0.333	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation
\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-100 Jolly-Seber population density estimates for __Eutamias minimus__ (least chipmunk) at grid D, sagebrush, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	1.025	0.001
2	0.190	0.488	8.2	43.1	4.0	199.1	12.7	1120.7	0.995	0.003
3	0.452	0.580	25.0	53.4	5.0	52.4	-8.7	88.6	0.927	0.004
4	0.857	0.466	39.0	45.1	4.2	11.0	68.6	933.0	1.416	0.049
5	0.786	0.374	59.4	74.9	7.0	201.1	0.9	21.5	0.507	0.012
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.947	0.562	32.1	33.8	3.2	6.5	1.8	6.1	0.888	0.010
12	0.917	0.377	29.4	31.9	3.0	9.4	11.6	32.2	0.998	0.011
13	0.895	0.563	30.4	33.7	3.2	9.9	29.6	184.9	1.056	0.037
14	0.895	0.535	31.8	35.5	3.3	40.1	0.3	3.3	0.681	0.092
15	0.938	0.652	23.0	24.5	2.3	96.4	*	*	*	*
16	0.000	*	*	*	*	*	*	*	*	*
17	0.167	0.143	7.0	42.0	*	2124.0	*	*	*	*
18	0.500	*	*	*	*	*	*	*	*	*
19	0.200	*	*	*	*	*	*	*	*	*
20	0.333	*	*	*	*	*	*	*	*	*
21	*	*	*	*	*	*	*	*	*	*
22	0.000	*	*	*	*	*	*	*	*	*
23	0.000	*	*	*	*	*	*	*	*	*
24	0.333	*	*	*	*	*	*	*	*	*
25	*	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-101 Jolly-Seber population density estimates for Eutamias minimus (least chipmunk) at grid E, mixed brush, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	0.969	0.003
2	0.391	0.489	18.4	47.0	4.2	80.4	-10.8	174.9	0.931	0.001
3	0.913	0.698	30.2	32.9	3.0	0.0	28.6	72.9	1.214	*
4	0.935	0.767	37.9	40.4	3.6	11.5	41.0	433.6	0.727	0.029
5	0.938	0.497	30.2	32.2	2.9	45.8	37.0	562.4	0.549	0.029
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.292	0.452	15.5	53.0	4.4	211.3	-2.2	379.5	0.761	0.012
12	0.647	0.461	24.6	36.9	3.1	30.1	88.3	2895.8	1.216	0.074
13	0.762	0.421	38.0	49.9	4.2	157.9	2.9	13.6	0.503	0.029
14	0.722	0.783	16.6	23.0	1.9	9.1	18.0	142.5	0.889	0.088
15	0.500	0.417	19.2	38.4	3.2	198.9	-4.9	31.9	0.437	0.031
16	1.000	0.545	11.0	11.0	*	6.7	40.0	4230.4	1.000	0.211
17	0.200	0.200	10.0	50.0	*	1160.0	-11.4	5180.5	1.093	0.329
18	0.455	0.254	19.7	43.3	*	594.0	61.1	36144.8	0.448	0.067
19	0.143	0.087	11.5	80.5	*	6036.2	*	*	*	*
20	0.455	*	*	*	*	*	*	*	*	*
21	1.000	*	*	*	*	*	*	*	*	*
22	0.000	*	28.0	*	*	*	23.3	*	0.257	0.075
23	0.400	0.444	9.0	22.5	2.2	229.7	*	*	*	*
24	0.333	*	*	*	*	*	*	*	*	*
25	0.400	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-102 Jolly-Seber population density estimates for *Eutamias minimus* (least chipmunk) at grid F, Douglas fir, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	*	*	*	*	*	*	*	*	*	*
2	*	*	*	*	*	*	*	*	*	*
3	*	*	*	*	*	*	*	*	*	*
4	*	*	*	*	*	*	*	*	*	*
5	*	*	*	*	*	*	*	*	*	*
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	*	*	*	*	*	*	*	*	*	*
12	0.000	*	0.0	*	*	*	7.0	*	1.000	0.000
13	0.500	0.333	3.0	6.0	0.6	12.0	3.5	239.6	1.750	1.172
14	0.500	0.143	7.0	14.0	1.4	180.0	3.5	145.9	0.750	0.375
15	0.429	0.500	6.0	14.0	1.4	67.7	*	*	0.500	0.125
16	0.000	*	4.5	*	*	*	15.7	*	0.667	0.074
17	0.333	0.200	5.0	15.0	1.5	120.0	-6.1	683.6	1.357	0.199
18	0.667	0.211	9.5	14.3	1.4	56.2	*	*	*	*
19	0.500	*	*	*	*	*	*	*	*	*
20	0.833	*	*	*	*	*	*	*	*	*
21	0.000	*	*	*	*	*	*	*	*	*
22	0.500	*	*	*	*	*	*	*	*	*
23	0.000	*	*	*	*	*	*	*	*	*
24	*	*	*	*	*	*	*	*	*	*
25	*	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-103 Jolly-Seber population density estimates for Eutamias minimus (least chipmunk) at grid G, aspen, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	0	var(0)
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.000	*	2.0	*	*	*	10.0	*	1.000	0.000
12	0.333	0.333	3.0	9.0	1.1	36.0	-6.4	271.1	1.600	0.768
13	1.000	0.250	8.0	8.0	0.9	24.0	5.6	12.2	0.521	0.136
14	0.429	0.720	4.2	9.7	1.1	6.3	*	*	*	*
15	0.500	*	*	*	*	*	1.4	*	0.200	*
16	1.000	1.000	1.0	1.0	*	0.0	*	*	*	*
17	*	*	*	*	*	*	*	*	*	*
18	0.000	*	*	*	*	*	*	*	*	*
19	1.000	1.000	1.0	1.0	*	0.0	1.0	0.0	1.000	0.000
20	0.500	1.000	1.0	2.0	*	0.0	*	*	*	*
21	*	*	*	*	*	*	*	*	*	*
22	*	*	*	*	*	*	*	*	*	*
23	0.250	1.000	1.0	4.0	*	0.0	*	*	*	*
24	0.500	*	*	*	*	*	*	*	*	*
25	1.000	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation
\- Grid not sampled

Table 3-7-104 Average extended range length (m) for adult *Eutamias minimus* (least chipmunk) on small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	14	108.0	12.4	11	98.2	10.5	25	103.7	8.2
B	Pinyon-juniper (south slope)	10	121.6	13.9	9	108.2	8.6	19	115.3	8.3
C	Pinyon-juniper (north slope)	4	123.4	9.5	2	191.5	19.0	6	146.1	16.3
D	Sagebrush	9	116.0	7.8	4	108.5	15.9	13	113.7	7.0
E	Mixed brush	9	125.4	8.6	8	128.2	22.4	17	126.7	11.1
F	Douglas fir	0			0			0		
	SUMMARY--ALL GRIDS	46	117.3	5.3	34	114.6	7.7	80	116.1	4.5

Table 3-7-105 Average extended range length (m) for adult Eutamias minimus (least chipmunk) on small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
A	Greasewood-sagebrush	7	118.5	13.7	2	91.1	26.2	9	112.4	12.0
B	Pinyon-juniper (south slope)	5	132.1	25.3	4	103.5	8.0	9	119.4	14.6
C	Pinyon-juniper (north slope)	0			2	106.6	3.3	2	106.6	3.3
D	Sagebrush	11	111.6	12.0	2	117.9	28.3	13	112.6	10.6
E	Mixed brush	5	158.[illegible]	26.3	2	136.8	47.2	7	152.0	21.2
F	Douglas fir	1	84.3		0			1	84.3	
G	Aspen	0			1	43.7		1	43.7	
	SUMMARY--ALL GRIDS	29	123.9	8.6	13	104.8	9.7	42	118.0	6.8

Table 3-7-106 Average extended range length (m) for adult _Eutamias minimus_ (least chipmunk) on small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	1	112.5		1	142.5		2	127.5	15.0
B	Pinyon-juniper (south slope)	1	136.7		1	103.3		2	120.0	16.7
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	1	130.7		1	56.0		2	93.4	37.3
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	3	126.6	7.3	3	100.6	25.0	6	113.6	14.6

Table 3-7-107 Average extended range length (m) for adult <u>Eutamias minimus</u> (least chipmunk) on small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	1	89.6		2	149.7	32.3	3	129.6	27.4
B	Pinyon-juniper (south slope)	2	146.4	32.7	3	143.1	45.0	5	144.5	26.7
C	Pinyon-juniper (north slope)	0			1	110.0		1	110.0	
D	Sagebrush	0			0			0		
E	Mixed brush	1	97.5		0			1	97.5	
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	4	120.0	20.3	6	139.8	22.6	10	131.9	16.3

Table 3-7-108 Average live weights (gm) for adult *Eutamias minimus* (least chipmunk) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			2	31.0	1.0	2	31.0	1.0
2	Sagebrush	6	33.5	1.4	5	36.8	2.0	11	35.0	1.2
3	Rabbitbrush	14	30.1	0.8	11	38.0	2.1	25	33.6	1.3
4	Pinyon-juniper/mixed brush	12	31.4	0.6	8	36.0	1.2	20	33.3	0.8
5	Mixed brush	12	32.0	0.8	13	37.2	1.1	25	34.7	0.9
6	Pinyon-juniper/sagebrush	9	31.9	0.9	2	34.0	2.0	11	32.3	0.8
7	Upland meadow	1	33.0		0			1	33.0	
A	Greasewood-sagebrush	25	32.4	0.6	17	36.8	2.1	42	34.2	0.9
B	Pinyon-juniper (south slope)	18	32.1	0.8	17	35.8	0.9	35	33.9	0.7
C	Pinyon-juniper (north slope)	8	33.9	1.8	9	40.0	2.0	17	37.1	1.5
D	Sagebrush	20	33.2	0.7	15	44.2	2.1	35	37.9	1.4
E	Mixed brush	23	31.2	0.5	25	33.7	0.5	48	32.5	0.4
F	Douglas fir	4	31.8	0.8	2	38.0	2.0	6	33.8	1.5
G	Aspen	5	35.2	2.1	9	36.4	0.8	14	36.0	0.9
	SUMMARY--ALL GRIDS	157	32.1	0.2	135	37.1	0.5	292	34.4	0.3

Table 3-7-109 Average live weights (gm) for adult *Eutamias minimus* (least chipmunk) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	MALE			FEMALE			ALL ADULTS		
		n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	10	32.5	0.9	7	34.3	0.9	17	33.2	0.6
3	Rabbitbrush	0			2	43.0	3.0	2	43.0	3.0
4	Pinyon-juniper/mixed brush	2	32.5	0.5	6	34.8	1.2	8	34.3	1.0
5	Mixed brush	1	26.0		3	39.0	2.1	4	35.8	3.6
6	Pinyon-juniper/sagebrush	2	30.5	0.5	2	30.5	0.5	4	30.5	0.3
7	Upland meadow	2	31.0	1.0	1	39.0		3	33.7	2.7
A	Greasewood-sagebrush	17	33.2	0.6	6	37.0	1.9	23	34.2	0.7
B	Pinyon-juniper (south slope)	16	32.1	1.0	16	34.7	1.2	32	33.4	0.8
C	Pinyon-juniper (north slope)	6	29.2	0.7	11	33.3	1.4	17	31.8	1.0
D	Sagebrush	7	32.0	1.6	7	33.9	2.0	14	32.9	1.3
E	Mixed brush	7	29.1	1.9	19	35.8	1.6	26	34.0	1.4
F	Douglas fir	4	34.8	0.6	6	37.7	4.8	10	36.5	2.8
G	Aspen	0			3	45.0	1.0	3	45.0	1.0
	SUMMARY--ALL GRIDS	74	31.9	0.4	89	35.7	0.6	163	34.0	0.4

Table 3-7-110 Average live weights (gm) for adult *Eutamias minimus* (least chipmunk) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	9	32.0	0.7	11	32.1	0.6	20	32.1	0.4
3	Rabbitbrush	1	32.0		3	33.7	0.9	4	33.3	0.8
4	Pinyon-juniper/mixed brush	1	33.0		1	32.0		2	32.5	0.5
5	Mixed brush	14	32.6	0.7	20	32.9	0.6	34	32.8	0.4
6	Pinyon-juniper/sagebrush	1	34.0		1	35.0		2	34.5	0.5
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	42	31.6	0.4	43	32.8	0.4	85	32.2	0.3
B	Pinyon-juniper (south slope)	22	33.0	0.5	14	35.1	0.7	36	33.9	0.5
C	Pinyon-juniper (north slope)	13	31.8	0.7	12	35.0	1.4	25	33.3	0.8
D	Sagebrush	2	31.0	2.0	3	33.3	1.5	5	32.4	1.2
E	Mixed brush	11	31.9	0.8	13	32.8	0.5	24	32.4	0.4
F	Douglas fir	5	33.2	1.0	3	36.7	0.7	8	34.5	0.9
G	Aspen	2	33.0	1.0	2	38.0	4.0	4	35.5	2.2
	SUMMARY--ALL GRIDS	123	32.2	0.2	126	33.4	0.3	249	32.8	0.2

Table 3-7-111 Percent diet composition for least chipmunks (Eutamias minimus) collected from major vegetation types during December, 1974 and May, July, and October, 1975 for RBOSP

Habitat/Sampling period	Sample Size	Food categroies (% composition) Seed	Succulent	Invertebrates	Vertebrates
Greasewood-Sagebrush					
December, 1974	0				
May, 1975	3	57	43	0	1
July, 1975	1	98	2	0	0
October, 1975	2	83	17	0	0
Total / Average	6	73	27	0	0
Pinyon-juniper (south slope)					
December, 1974	1	98	0	0	2
May, 1975	0				
July, 1975	1	100	0	0	0
October, 1975	0				
Total / Average	2	99	0	0	1
Pinyon-juniper (north slope)					
No individuals captured					
Sagebrush					
December, 1974	0				
May, 1975	4	37	59	4	0
July, 1975	0				
October, 1975	0				
Total / Average	4	37	59	4	0
Mixed Brush					
December, 1974	0				
May, 1975	3	57	43	0	1
July, 1975	1	98	2	0	0
October, 1975	2	83	17	0	0
Total / Average	6	72	28	0	0
Aspen					
No individuals captured					

Table 3-7-112 Average percent diet composition for deer mice (Peromyscus maniculatus), least chipmunks (Eutamias minimus), and long-tailed voles (Microtus longicaudus) collected from major vegetation types during December, 1974 and May, July, and October, 1975 for RBOSP

Species/Sampling period	Sample Size	Food categories (average % composition)			
		Seed	Succulent	Invertebrates	Vertebrates
Peromyscus maniculatus (deer mouse)					
December, 1974	15	82	13	3	3
May, 1975	19	64	26	9	1
July, 1975	15	87	10	2	1
October, 1975	6	60	38	0	2
	Total 55	Average 75	19	4	2
Eutamias minimus (least chipmunk)					
December, 1974	1	98	0	0	2
May, 1975	10	49	49	2	0
July, 1975	3	99	1	0	0
October, 1975	4	83	17	0	0
	Total 18	Average 68	31	1	0
Microtus longicaudus (long-tailed vole)					
December, 1974	0				
May, 1975	4	96	3	1	0
July, 1975	5	6	94	0	0
October, 1975	4	12	88	0	0
	Total 13	Average 36	64	0	0

Table 3-7-113 Reproductive status* of female deer mice (Peromyscus maniculatus), least chipmunks (Eutamias minimus) and long-tailed voles (Microtus longicaudus) collected in major vegetation types during May, July and October, 1975 for RBOSP

Species/Habitat type	May 1975 Active	May 1975 Inactive	July 1975 Active	July 1975 Inactive	October 1975 Active	October 1975 Inactive
Peromyscus maniculatus (deer mouse)						
Greasewood-sagebrush	3	1	5	0	3	0
Pinyon-juniper (south slope)	3	2	1	0	0	0
Pinyon-juniper (north slope)	1	0	1	0	0	0
Mixed brush	0	0	3	0	1	2
Sagebrush	2	1	0	0	0	2
Total	9	4	10	0	4	4
Eutamias minimus (least chipmunk)						
Greasewood-sagebrush	1	4	0	0	0	5
Pinyon-juniper (south slope)	3	0	1	0	0	0
Pinyon-juniper (north slope)	0	0	0	0	0	0
Mixed brush	1	3	0	1	0	1
Sagebrush	1	1	0	0	0	0
Total	6	8	1	1	0	6
Microtus longicaudus (long-tailed vole)						
Aspen	0	3	3	0	2	2

* A female that contained embryos or recent placental scars was considered to be reproductively active.

Table 3-7-114 Average number of embryos* found in reproductively active deer mice (<u>Peromyscus maniculatus</u>) least chipmunks (<u>Eutamias minimus</u>), and long-tailed voles (<u>Microtus longicaudus</u>) collected from major vegetation types during May, July and October, 1975 for RBOSP

Species/Habitat type	May 1975		July 1975		October 1975	
	Sample size	Average	Sample Size	Average	Sample Size	Average
<u>Peromyscus maniculatus</u> (deer mouse)						
Greasewood-sagebrush	3	5.6	6	6.0	3	6.7
Pinyon-juniper (south slope)	3	5.3	1	6.0	0	
Pinyon-juniper (north slope)	1	6.0	1	6.0	0	
Mixed brush	0		3	4.7	1	6.0
Sagebrush	2	4.5	0		0	
Summary	9	5.3	11	5.6	4	6.5
<u>Eutamias minimus</u> (least chipmunk)						
Greasewood-sagebrush	1	6.0	0		0	
Pinyon-juniper (south slope)	3	7.0	1	7.0	0	
Pinyon-juniper (north slope)	0		0		0	
Mixed brush	1	7.0	0		0	
Sagebrush	1	4.0	0		0	
Summary	6	6.3	1	7.0	0	
<u>Microtus longicaudus</u> (long-tailed vole)						
Aspen	0		3	5.0	2	4.0

* Both number of embryos and number of recent placental scars are used in the analysis.

Table 3-7-115 Summary of trapping results for Eutamias quadrivittatus (Colorado chipmunk) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP .

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	3.03	43.7	0.40	0.60	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	1.80	26.0	0.42	0.58	0.00	0.00
C	Pinyon-juniper (north slope)	2.11	30.3	0.36	0.64	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-116 Summary of trapping results for Eutamias quadrivittatus (Colorado chipmunk) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	1.82	38.9	0.67	0.33	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	1.80	38.6	0.42	0.58	0.00	0.00
C	Pinyon-juniper (north slope)	1.05	22.5	0.29	0.71	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-117 Summary of trapping results for Eutamias quadrivittatus (Colorado chipmunk) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	F	Juvenile M	F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	1.80	60.0	0.50	0.50	0.00	0.00
C	Pinyon-juniper (north slope)	1.20	40.0	0.38	0.63	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-118 Summary of trapping results for Eutamias quadrivittatus (Colorado chipmunk) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	1.82	54.7	0.00	1.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.30	9.1	1.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	1.20	36.2	0.63	0.38	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-119 Jolly-Seber population density estimates for <u>Eutamias quadrivittatus</u> (Colorado chipmunk) at grid B, pinyon-juniper (south slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	0	var(0)
1	0.000	*	0.0	*	*	*	*	*	1.000	0.000
2	0.000	*	3.0	*	*	*	14.0	*	1.000	0.000
3	0.385	1.000	5.0	13.0	1.0	0.0	3.9	7.3	0.879	0.020
4	0.714	0.517	9.7	13.5	1.1	7.6	2.4	13.5	0.857	0.017
5	0.714	0.500	10.0	14.0	1.1	5.6	2.3	21.2	1.167	0.021
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.750	0.429	14.0	18.7	1.7	17.8	-2.0	7.1	0.750	0.023
12	1.000	0.333	12.0	12.0	1.1	0.0	*	*	*	*
13	1.000	*	*	*	*	*	*	*	*	*
14	1.000	0.429	7.0	7.0	0.6	0.0	3.6	1.5	1.018	0.001
15	0.667	0.842	7.1	10.7	1.0	1.4	6.2	48.8	1.383	0.292
16	0.667	0.286	14.0	21.0	*	105.0	*	*	*	*
17	*	*	*	*	*	*	*	*	*	*
18	1.000	*	*	*	*	*	*	*	*	*
19	0.667	*	*	*	*	*	*	*	*	*
20	0.000	*	*	*	*	*	*	*	*	*
21	*	*	*	*	*	*	*	*	*	*
22	*	*	*	*	*	*	*	*	*	*
23	0.000	*	*	*	*	*	*	*	*	*
24	*	*	*	*	*	*	*	*	*	*
25	*	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation
\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-120 Jolly-Seber population density estimates for Eutamias quadrivittatus (Colorado chipmunk) at grid C, pinyon-juniper (north slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	1.100	0.013
2	0.667	0.455	8.8	13.2	1.1	11.8	-0.9	9.7	0.860	0.026
3	0.889	0.862	9.3	10.4	0.9	0.7	1.3	1.2	0.856	0.030
4	0.857	0.682	8.8	10.3	0.8	2.9	4.2	18.8	1.224	0.361
5	0.714	0.417	12.0	16.8	1.4	78.0	-1.2	4.3	0.429	0.112
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	1.000	0.333	6.0	6.0	*	12.0	5.0	92.0	0.833	0.588
12	0.500	0.200	5.0	10.0	*	88.0	-0.7	43.7	0.667	0.296
13	0.667	0.500	4.0	6.0	*	12.0	*	*	*	*
14	1.000	*	*	*	*	*	*	*	*	*
15	0.000	*	*	*	*	*	*	*	*	*
16	0.000	*	2.0	*	*	*	6.8	*	0.750	0.438
17	0.500	0.333	3.0	6.0	*	28.0	*	*	*	*
18	0.000	*	*	*	*	*	*	*	*	*
19	0.500	*	*	*	*	*	*	*	*	*
20	*	*	*	*	*	*	*	*	*	*
21	0.000	*	3.0	*	*	*	*	*	*	*
22	1.000	*	*	*	*	*	*	*	*	*
23	0.250	*	*	*	*	*	*	*	*	*
24	*	*	*	*	*	*	*	*	*	*
25	0.000	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-121 Average extended range length (m) for adult Eutamias quadrivittatus (Colorado chipmunk) on small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	1	110.0		2	193.6	76.3	3	165.7	52.1
C	Pinyon-juniper (north slope)	1	188.2		4	152.9	21.6	5	159.9	18.1
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
	SUMMARY--ALL GRIDS	2	149.1	39.1	6	166.5	25.4	8	162.1	21.9

Table 3-7-122 Average extended range length (m) for adult Eutamias quadrivittatus (Colorado chipmunk) on small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			2	129.9	12.6	2	129.9	12.6
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	0			2	129.9	12.6	2	129.9	12.6

Table 3-7-123 Average live weights (gm) for adult Eutamias quadrivittatus (Colorado chipmunk) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	2	50.0	1.0	1	81.0		3	60.3	10.3
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	5	47.6	2.2	7	51.1	2.4	12	49.7	1.7
C	Pinyon-juniper (north slope)	2	51.5	2.5	5	55.4	1.6	7	54.3	1.4
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	9	49.0	1.4	13	55.1	2.6	22	52.6	1.8

3-7-380

Table 3-7-124 Average live weights (gm) for adult *Eutamias quadrivittatus* (Colorado chipmunk) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	6	51.0	1.1	6	57.8	3.1	12	54.4	1.9
C	Pinyon-juniper (north slope)	3	48.7	2.6	5	52.6	4.8	8	51.1	3.1
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	9	50.2	1.1	11	55.5	2.7	20	53.1	1.7

Table 3-7-125 Average live weights (gm) for adult Eutamias quadrivittatus (Colorado chipmunk) on all small mammal grids during sample period 5, Sept. 31-Oct. 4,1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			3	48.3	2.0	3	48.3	2.0
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	2	49.5	1.5	0			2	49.5	1.5
C	Pinyon-juniper (north slope)	5	46.2	1.6	2	51.5	1.5	7	47.7	1.5
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	7	47.1	1.3	5	49.6	1.4	12	48.2	1.0

Table 3-7-126 Summary of trapping results for *Peromyscus maniculatus* (deer mouse) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	9.70	10.8	0.19	0.81	0.00	0.00
2	Sagebrush	4.85	5.4	0.25	0.75	0.00	0.00
3	Rabbitbrush	7.88	8.7	0.62	0.38	0.00	0.00
4	Pinyon-juniper/mixed brush	11.52	12.8	0.79	0.21	0.00	0.00
5	Mixed brush	7.88	8.7	0.62	0.38	0.00	0.00
6	Pinyon-juniper/sagebrush	10.91	12.1	0.22	0.78	0.00	0.00
7	Upland meadow	4.85	5.4	0.50	0.50	0.00	0.00
A	Greasewood-sagebrush	10.38	11.5	0.51	0.48	0.00	0.01
B	Pinyon-juniper (south slope)	4.96	5.5	0.45	0.55	0.00	0.00
C	Pinyon-juniper (north slope)	7.37	8.2	0.51	0.49	0.00	0.00
D	Sagebrush	6.62	7.3	0.45	0.55	0.00	0.00
E	Mixed brush	2.26	2.5	0.73	0.27	0.00	0.00
F	Douglas fir	1.22	1.4	0.33	0.67	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-127 Summary of trapping results for <u>Peromyscus maniculatus</u> (deer mouse) on all small mammal grids during sample period 2, December 7-12, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	10.30	18.9	0.53	0.47	0.00	0.00
2	Sagebrush	4.85	8.9	0.63	0.38	0.00	0.00
3	Rabbitbrush	12.73	23.3	0.48	0.52	0.00	0.00
4	Pinyon-juniper/mixed brush	2.42	4.4	0.75	0.25	0.00	0.00
5	Mixed brush	0.61	1.1	0.00	1.00	0.00	0.00
6	Pinyon-juniper/sagebrush	6.06	11.1	0.30	0.70	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	8.48	15.6	0.57	0.43	0.00	0.00
B	Pinyon-juniper (south slope)	7.88	14.4	0.46	0.54	0.00	0.00
C	Pinyon-juniper (north slope)	0.61	1.1	0.00	1.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.61	1.1	1.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours

** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-123 Summary of trapping results for *Peromyscus maniculatus* (deer mouse) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights*	Relative Abundance**	Proportion Captured: Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	4.24	5.2	0.71	0.29	0.00	0.00
2	Sagebrush	4.24	5.2	0.57	0.43	0.00	0.00
3	Rabbitbrush	16.36	20.0	0.48	0.52	0.00	0.00
4	Pinyon-juniper/mixed brush	7.88	9.6	0.46	0.54	0.00	0.00
5	Mixed brush	7.88	9.6	0.38	0.46	0.08	0.08
6	Pinyon-juniper/sagebrush	12.73	15.5	0.43	0.57	0.00	0.00
7	Upland meadow	7.27	8.9	0.75	0.17	0.00	0.08
A	Greasewood-sagebrush	5.26	6.4	0.49	0.51	0.00	0.00
B	Pinyon-juniper (south slope)	4.96	6.1	0.48	0.52	0.00	0.00
C	Pinyon-juniper (north slope)	4.06	5.0	0.41	0.59	0.00	0.00
D	Sagebrush	3.31	4.0	0.50	0.50	0.00	0.00
E	Mixed brush	3.46	4.2	0.52	0.48	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.33	0.4	0.00	1.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours

** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-129 Summary of trapping results for Peromyscus maniculatus (deer mouse) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	4.04	6.5	0.75	0.25	0.00	0.00
2	Sagebrush	4.24	6.9	0.29	0.43	0.29	0.00
3	Rabbitbrush	10.30	16.7	0.41	0.47	0.06	0.06
4	Pinyon-juniper/mixed brush	3.64	5.9	0.50	0.50	0.00	0.00
5	Mixed brush	4.85	7.8	0.38	0.63	0.00	0.00
6	Pinyon-juniper/sagebrush	7.88	12.8	0.54	0.46	0.00	0.00
7	Upland meadow	6.67	10.8	0.55	0.18	0.18	0.09
A	Greasewood-sagebrush	6.47	10.5	0.35	0.28	0.21	0.16
B	Pinyon-juniper (south slope)	3.01	4.9	0.25	0.65	0.10	0.00
C	Pinyon-juniper (north slope)	3.16	5.1	0.57	0.38	0.05	0.00
D	Sagebrush	3.01	4.9	0.35	0.50	0.00	0.15
E	Mixed brush	4.21	6.8	0.36	0.46	0.04	0.14
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.33	0.5	1.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-130 Summary of trapping results for Peromyscus maniculatus (deer mouse) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	3.64	3.2	0.17	0.33	0.33	0.17
2	Sagebrush	2.42	2.1	0.00	0.25	0.25	0.50
3	Rabbitbrush	20.00	17.4	0.52	0.21	0.18	0.09
4	Pinyon-juniper/mixed brush	8.48	7.4	0.21	0.36	0.14	0.29
5	Mixed brush	12.12	10.5	0.20	0.30	0.35	0.15
6	Pinyon-juniper/sagebrush	12.73	11.1	0.24	0.33	0.14	0.29
7	Upland meadow	9.70	8.4	0.44	0.31	0.13	0.13
A	Greasewood-sagebrush	10.53	9.2	0.29	0.16	0.21	0.34
B	Pinyon-juniper (south slope)	5.41	4.7	0.36	0.19	0.14	0.31
C	Pinyon-juniper (north slope)	4.21	3.7	0.36	0.14	0.25	0.25
D	Sagebrush	5.11	4.4	0.21	0.32	0.26	0.21
E	Mixed brush	12.78	11.1	0.45	0.33	0.13	0.09
F	Douglas fir	4.26	3.7	-	-	-	-
G	Aspen	3.61	3.1	0.64	0.18	0.18	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100
\- Positive sex identification could not be made in the field

Table 3-7-131 Jolly-Seber population density estimates for Peromyscus maniculatus (deer mouse) at grid A, greasewood-sagebrush, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	0	var(0)
1	0.000	*	0.0	*	*	*	*	*	0.838	0.009
2	0.515	0.774	22.6	42.6	4.2	20.1	45.3	672.7	1.067	0.048
3	0.542	0.323	40.3	74.4	7.4	367.6	9.2	540.8	1.008	0.134
4	0.600	0.247	48.7	81.1	8.0	838.6	9.6	491.7	0.829	0.223
5	0.611	0.234	47.0	76.9	7.6	1606.1	13.9	166.7	0.187	0.010
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.357	0.495	10.1	28.3	2.7	66.6	3.3	113.1	0.786	0.012
12	0.588	0.667	15.0	25.5	2.4	8.9	-0.1	24.3	1.164	0.011
13	0.867	0.508	25.6	29.5	2.8	17.2	9.3	25.9	0.895	0.034
14	0.684	0.546	23.8	34.8	3.3	42.9	2.3	38.6	1.019	0.179
15	0.800	0.409	29.3	36.7	3.5	223.9	18.9	124.4	0.234	0.014
16	0.263	0.703	7.1	27.0	*	33.8	10.0	187.1	1.061	0.008
17	0.579	0.512	22.3	37.1	*	37.2	6.8	63.8	0.932	0.018
18	0.714	0.542	28.2	38.8	*	32.4	10.7	47.4	0.774	0.018
19	0.737	0.539	26.5	35.3	*	25.9	106.5	9559.6	1.706	0.649
20	0.667	0.133	60.0	90.0	*	2164.5	27.7	827.1	0.271	0.019
21	0.333	0.288	17.4	52.1	5.5	291.1	2.4	886.7	0.987	0.017
22	0.440	0.549	21.0	45.5	4.8	62.2	15.5	161.9	0.904	0.013
23	0.607	0.565	30.8	49.5	5.2	46.8	36.0	377.2	0.935	0.031
24	0.593	0.504	32.5	53.5	5.6	105.8	554.7	*	0.533	*
25	0.714	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-132 Jolly-Seber population density estimates for *Peromyscus maniculatus* (deer mouse) at grid B, pinyon-juniper (south slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	1.083	0.042
2	0.313	0.385	13.0	41.6	3.4	220.2	-0.4	498.4	0.903	0.063
3	0.583	0.323	21.7	37.1	3.0	139.4	-2.0	167.7	1.065	0.244
4	0.750	0.220	27.3	36.4	3.0	275.0	7.3	194.2	0.972	0.464
5	0.667	0.211	28.5	42.8	3.5	700.3	13.8	96.2	0.237	0.022
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.313	0.670	7.5	23.9	2.2	32.6	3.8	69.0	0.826	0.010
12	0.647	0.744	15.2	22.9	2.1	4.7	21.3	147.5	1.235	0.041
13	0.750	0.444	27.0	36.0	3.4	61.7	3.1	16.2	0.622	0.026
14	0.750	0.643	18.7	24.9	2.3	16.0	29.9	2363.1	2.446	4.605
15	0.600	0.057	53.0	88.3	8.3	7092.6	-0.1	139.9	0.236	0.046
16	0.625	0.385	13.0	20.8	2.1	33.6	10.3	188.5	0.917	0.055
17	0.500	0.273	14.7	29.3	3.0	111.4	-9.3	446.5	1.554	0.657
18	0.800	0.138	29.0	36.3	3.7	408.2	-4.2	37.2	0.667	0.207
19	1.000	0.200	20.0	20.0	2.0	80.0	9.0	86.2	1.125	0.629
20	0.714	0.222	22.5	31.5	3.2	344.2	10.5	194.6	0.408	0.070
21	0.429	0.300	10.0	23.3	2.4	129.8	10.3	264.6	0.679	0.056
22	0.364	0.421	9.5	26.1	2.7	86.3	1.8	113.0	0.758	0.021
23	0.579	0.915	12.5	20.8	2.1	2.9	31.4	421.2	0.976	0.085
24	0.600	0.446	20.2	33.7	3.5	128.7	*	*	*	*
25	0.692	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-133 Jolly-Seber population density estimates for *Peromyscus maniculatus* (deer mouse) at grid C, pinyon-juniper (north slope), after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	0	var(0)
1	0.000	*	0.0	*	*	*	*	*	0.897	0.009
2	0.588	0.558	17.9	30.5	2.8	21.4	12.6	99.3	1.000	0.013
3	0.579	0.461	24.8	41.2	3.8	50.4	8.7	73.6	0.901	0.015
4	0.704	0.654	29.5	41.3	3.8	23.8	69.1	1514.8	1.068	0.080
5	0.727	0.389	41.1	56.6	5.2	251.6	2.1	15.5	0.330	0.011
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.750	0.579	15.5	20.7	1.8	6.7	13.0	86.3	1.111	0.025
12	0.571	0.388	20.6	36.1	3.1	71.9	-2.8	98.7	0.990	0.063
13	0.800	0.304	26.3	32.9	2.8	73.0	7.2	93.7	0.953	0.115
14	0.700	0.259	27.0	38.6	3.3	169.7	-5.6	531.6	2.167	3.895
15	0.833	0.077	65.0	78.0	6.8	4939.2	4.1	43.1	0.193	0.032
16	0.667	0.314	12.8	19.1	1.6	34.5	-3.5	21.6	0.800	0.032
17	1.000	0.636	11.0	11.0	0.9	0.0	32.0	2202.7	1.778	0.422
18	0.333	0.125	16.0	48.0	4.0	1092.0	-24.5	1707.0	0.875	0.259
19	1.000	0.286	17.5	17.5	1.5	65.6	25.0	940.0	1.429	2.166
20	0.500	0.200	25.0	50.0	4.2	2360.0	17.3	2218.1	0.133	0.017
21	0.167	0.250	4.0	24.0	*	441.0	18.0	3859.7	0.857	0.082
22	0.200	0.259	7.7	38.6	*	537.0	-6.4	1899.6	0.891	0.064
23	0.500	0.357	14.0	28.0	*	95.4	-0.5	64.1	0.733	0.050
24	0.643	0.818	11.0	17.1	*	7.8	*	*	*	*
25	0.778	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation
\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-134 Jolly-Seber population density estimates for Peromyscus maniculatus (deer mouse) at grid D, sagebrush, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	0.803	0.013
2	0.588	0.733	13.6	23.2	2.1	8.7	14.3	60.4	0.891	0.012
3	0.526	0.543	18.4	35.0	3.2	35.3	-1.3	38.1	0.833	0.008
4	0.815	1.008	22.0	26.8	2.4	*	42.1	582.7	0.480	0.010
5	0.706	1.000	12.0	17.0	1.6	*	*	*	0.206	0.013
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.000	*	3.5	*	*	*	28.6	*	0.987	0.032
12	0.375	0.579	10.4	27.6	2.1	51.5	-1.7	68.6	0.786	0.025
13	0.800	0.500	16.0	20.0	1.6	13.3	3.2	21.4	0.975	0.071
14	0.750	0.385	15.6	20.8	1.6	33.6	-2.9	13.8	0.909	0.125
15	1.000	0.500	16.0	16.0	1.2	26.7	13.3	84.3	0.417	0.038
16	0.333	0.600	6.7	20.0	1.9	36.4	0.4	71.9	0.818	0.024
17	0.714	0.417	12.0	16.8	1.6	14.0	-3.6	21.6	1.286	0.177
18	1.000	0.333	18.0	18.0	1.7	36.0	4.1	24.2	0.917	0.300
19	0.800	0.242	16.5	20.6	2.0	118.7	6.3	59.5	0.629	0.159
20	0.571	0.364	11.0	19.3	1.9	82.4	39.3	11675.8	0.607	0.095
21	0.167	0.118	8.5	51.0	*	2216.3	-14.2	6308.2	0.727	0.046
22	0.429	0.611	9.8	22.9	*	26.7	1.8	45.4	0.885	0.021
23	0.714	0.634	15.8	22.1	*	12.4	13.9	76.3	0.966	0.064
24	0.529	0.496	18.1	34.3	*	96.9	*	*	*	*
25	0.786	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation
\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-135 Jolly-Seber population density estimates for Cleithrionomys gapperi (red-backed vole) at grid F, Douglas fir, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	O	var(O)
1	0.000	*	0.0	*	*	*	*	*	0.750	0.103
2	0.286	0.533	3.8	13.1	1.5	48.8	1.6	69.4	0.724	0.088
3	0.571	0.632	6.3	11.1	1.2	17.6	11.8	185.1	0.696	0.196
4	0.333	0.462	6.5	19.5	2.2	163.6	*	*	*	*
5	1.000	*	*	*	*	*	*	*	*	*
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.125	0.333	3.0	24.0	2.7	496.0	-2.4	1108.8	0.600	0.060
12	0.500	0.333	6.0	12.0	1.4	34.7	0.0	227.8	1.750	1.839
13	0.667	0.143	14.0	21.0	2.4	333.0	4.2	63.7	0.467	0.162
14	0.500	0.429	7.0	14.0	1.6	45.3	3.5	151.6	1.300	1.274
15	0.600	0.231	13.0	21.7	2.4	381.5	*	*	*	*
16	0.500	*	*	*	*	*	*	*	*	*
17	1.000	0.500	2.0	2.0	*	0.0	*	*	3.000	6.000
18	0.000	*	6.0	*	*	*	*	*	*	*
19	0.000	*	*	*	*	*	18.0	*	6.000	*
20	0.500	0.333	6.0	12.0	*	120.0	0.0	5.6	0.250	0.047
21	0.667	1.000	2.0	3.0	0.3	0.0	2.0	8.0	1.000	0.000
22	0.500	0.500	2.0	4.0	0.5	4.0	*	*	*	*
23	1.000	*	*	*	*	*	*	*	*	*
24	1.000	*	*	*	*	*	*	*	*	*
25	0.500	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation

\- Comparable estimates of population size are not possible for winter samples (trap nights 6-10) due to a reduction in sampling effort

Table 3-7-136 Average extended range length (m) for adult Peromyscus maniculatus (deer mouse) on small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
A	Greasewood-sagebrush	5	105.5	12.6	5	85.7	9.0	10	95.6	8.0
B	Pinyon-juniper (south slope)	1	264.4		3	125.7	5.7	4	160.4	34.9
C	Pinyon-juniper (north slope)	7	104.3	16.9	5	140.3	19.7	12	119.3	13.4
D	Sagebrush	5	94.7	7.5	4	156.7	40.8	9	122.3	20.3
E	Mixed brush	6	129.2	13.0	0			6	129.2	13.0
F	Douglas fir	0			0			0		
	SUMMARY--ALL GRIDS	24	115.4	9.3	17	125.5	12.5	41	119.6	7.6

Table 3-7-137 Average extended range length (m) for adult Peromyscus maniculatus (deer mouse) on small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	5	123.6	18.6	3	81.2	16.3	8	107.7	14.6
B	Pinyon-juniper (south slope)	5	116.8	19.0	4	109.5	16.5	9	113.6	12.2
C	Pinyon-juniper (north slope)	3	153.9	23.6	2	118.7	53.8	5	139.8	23.0
D	Sagebrush	5	184.1	27.6	2	160.4	29.8	7	177.3	20.6
E	Mixed brush	4	112.4	15.8	6	99.4	16.2	10	104.6	11.2
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	22	137.9	10.7	17	108.0	10.3	39	124.9	7.9

Table 3-7-138 Average extended range length (m) for adult Peromyscus maniculatus (deer mouse) on small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			3	90.2	17.2	3	90.2	17.2
C	Pinyon-juniper (north slope)	0			4	154.1	22.1	4	154.1	22.1
D	Sagebrush	1	149.8		2	77.3	12.3	3	101.4	25.2
E	Mixed brush	3	108.5	11.3	0			3	108.5	11.3
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	4	118.8	13.0	9	115.7	16.1	13	116.7	12.1

Table 3-7-139 Average extended range length (m) for adult *Peromyscus maniculatus* (deer mouse) on small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
A	Greasewood-sagebrush	2	77.3	12.3	0			2	77.3	12.3
B	Pinyon-juniper (south slope)	2	90.9	6.6	1	69.9		3	83.9	8.0
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			2	87.4	22.5	2	87.4	22.5
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	4	84.1	6.9	3	81.6	14.3	7	83.0	7.2

Table 3-7-140 Average live weights (gm) for adult *Peromyscus maniculatus* (deer mouse) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	4	19.0	1.3	2	19.0	2.0	6	19.0	1.0
2	Sagebrush	4	20.8	0.5	3	27.7	3.5	7	23.7	1.9
3	Rabbitbrush	13	19.8	0.8	13	19.0	0.7	26	19.4	0.5
4	Pinyon-juniper/mixed brush	6	20.5	1.6	7	21.9	1.1	13	21.2	0.9
5	Mixed brush	5	20.4	1.5	6	21.0	1.4	11	20.7	1.0
6	Pinyon-juniper/sagebrush	9	20.9	1.3	12	21.2	1.0	21	21.0	0.8
7	Upland meadow	9	21.9	0.5	2	20.0	4.0	11	21.5	0.7
A	Greasewood-sagebrush	17	21.7	0.4	18	23.3	0.9	35	22.5	0.5
B	Pinyon-juniper (south slope)	16	20.6	0.8	17	19.6	0.5	33	20.1	0.5
C	Pinyon-juniper (north slope)	11	19.3	0.7	15	21.3	1.2	26	20.4	0.8
D	Sagebrush	11	20.9	0.6	11	20.5	1.0	22	20.7	0.6
E	Mixed brush	12	19.3	1.0	10	19.7	0.4	22	19.5	0.5
F	Douglas fir	0			0			0		
G	Aspen	0			1	20.0		1	20.0	
	SUMMARY--ALL GRIDS	117	20.5	0.3	117	21.0	0.3	234	20.7	0.2

Table 3-7-141 Average live weights (gm) for adult *Peromyscus maniculatus* (deer mouse) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	3	21.3	1.9	1	18.0		4	20.5	1.6
2	Sagebrush	2	22.0	1.0	2	29.5	3.5	4	25.8	2.6
3	Rabbitbrush	6	21.8	1.1	8	23.0	1.5	14	22.5	0.9
4	Pinyon-juniper/mixed brush	3	18.0	1.0	3	27.7	3.3	6	22.8	2.7
5	Mixed brush	3	18.7	0.9	5	23.0	1.9	8	21.4	1.4
6	Pinyon-juniper/sagebrush	7	18.7	1.9	6	24.3	1.5	13	21.3	1.4
7	Upland meadow	6	18.0	1.5	2	20.5	1.5	8	18.6	1.2
A	Greasewood-sagebrush	14	20.4	1.0	12	22.1	1.2	26	21.2	0.8
B	Pinyon-juniper (south slope)	5	17.6	1.4	13	23.5	0.7	18	21.8	0.9
C	Pinyon-juniper (north slope)	10	18.9	1.4	6	22.5	1.3	16	20.3	1.0
D	Sagebrush	7	21.7	1.2	10	23.4	1.4	17	22.7	1.0
E	Mixed brush	10	18.6	1.1	13	23.6	1.7	23	21.4	1.2
F	Douglas fir	0			0			0		
G	Aspen	1	15.0		0			1	15.0	
	SUMMARY---ALL GRIDS	77	19.5	0.4	81	23.4	0.5	158	21.5	0.4

Table 3-7-142 Average live weights (gm) for adult *Peromyscus maniculatus* (deer mouse) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	1	16.0		2	13.5	0.5	3	14.3	0.9
2	Sagebrush	0			1	15.0		1	15.0	
3	Rabbitbrush	16	17.6	0.5	7	17.6	1.3	23	17.6	0.5
4	Pinyon-juniper/mixed brush	3	15.3	2.0	5	15.8	0.4	8	15.6	0.7
5	Mixed brush	4	18.0	1.6	6	21.3	1.8	10	20.0	1.3
6	Pinyon-juniper/sagebrush	5	17.0	0.8	7	18.1	0.9	12	17.7	0.6
7	Upland meadow	7	15.0	0.8	5	18.8	0.4	12	16.6	0.7
A	Greasewood-sagebrush	20	16.6	0.5	10	19.5	1.9	30	17.6	0.7
B	Pinyon-juniper (south slope)	13	16.7	0.6	7	17.3	0.8	20	16.9	0.5
C	Pinyon-juniper (north slope)	10	16.9	0.6	4	18.0	1.4	14	17.2	0.6
D	Sagebrush	6	15.7	0.9	10	18.7	0.4	16	17.6	0.5
E	Mixed brush	38	14.4	0.3	28	16.3	0.6	66	15.2	0.3
F	Douglas fir	5	15.6	0.8	6	14.5	0.7	11	15.0	0.5
G	Aspen	7	15.3	0.7	1	13.0		8	15.0	0.7
	SUMMARY--ALL GRIDS	135	15.9	0.2	99	17.4	0.3	234	16.6	0.2

Table 3-7-143 Percent diet composition for deer mice (Peromyscus maniculatus) collected from major vegetation type during December, 1974 and May, July, and October, 1975 for RBOSP

Habitat/Sampling period	Sample Size	Seed	Succulent	Invertebrates	Vertebrates
		Food categories (% composition)			
Greasewood-Sagebrush					
December, 1974	5	89	9	1	2
May, 1975	4	85	12	2	1
July, 1975	5	98	2	1	0
October, 1975	2	77	21	0	2
Total	16	Average 89	9	1	1
Pinyon-juniper (south slope)					
December, 1974	5	79	16	5	1
May, 1975	4	69	24	7	0
July, 1975	2	79	21	0	0
October, 1975	0				
Total	11	Average 75	20	5	1
Pinyon-juniper (north slope)					
December, 1974	0				
May, 1975	3	79	18	3	0
July, 1975	2	100	0	0	0
October, 1975	0				
Total	5	Average 87	11	2	0
Sagebrush					
December, 1974	5	78	14	3	5
May, 1975	5	40	36	23	1
July, 1975	1	94	4	2	0
October, 1975	2	54	42	0	4
Total	13	61	26	10	3

Table 3-7-143 (Continued)

Habitat/Sampling period	Sample Size	Food categories (% composition) Seed	Succulent	Invertebrates	Vertebrates
Mixed Brush					
December, 1974	0				
May, 1975	3	56	38	3	3
July, 1975	5	74	20	4	2
October, 1975	2	48	51	1	0
	Total 10	Average 63	32	3	2
Aspen					
No individuals captured					

Table 3-7-144 Summary of trapping results for Peromyscus truei (piñon mouse) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured: Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.45	50.0	0.67	0.33	0.00	0.00
C	Pinyon-juniper (north slope)	0.45	50.0	0.33	0.67	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-143 (Continued)

Habitat/Sampling period	Sample Size	Food categories (% composition) Seed	Succulent	Invertebrates	Vertebrates
Mixed Brush					
December, 1974	0				
May, 1975	3	56	38	3	3
July, 1975	5	74	20	2	2
October, 1975	2	48	51	1	0
		[illegible]	[illegible]	3	2
Aspen					
No individuals captured					

Table 3-7-145 Summary of trapping results for Peromyscus truei (piñon mouse) on all small mammal grids during sample period 2, December 7-12, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Proportion Captured Adult F	Proportion Captured Juvenile M	Proportion Captured Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	1.21	66.7	1.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.61	33.3	1.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-146 Summary of trapping results for Peromyscus truei (piñon mouse) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.90	75.0	0.67	0.33	0.00	0.00
C	Pinyon-juniper (north slope)	0.30	25.0	0.50	0.50	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-147 Summary of trapping results for Peromyscus truei (piñon mouse) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	F	Juvenile M	F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.45	42.9	0.33	0.67	0.00	0.00
C	Pinyon-juniper (north slope)	0.60	57.1	0.50	0.50	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-148 Summary of trapping results for Peromyscus truei (piñon mouse) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.75	83.3	0.80	0.20	0.00	0.00
C	Pinyon-juniper (north slope)	0.15	16.7	0.00	1.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-149 Average live weights (gm) for adult *Peromyscus truei* (piñon mouse) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	4	21.3	0.9	2	24.5	3.5	6	22.3	1.3
C	Pinyon-juniper (north slope)	1	22.0		1	23.0		2	22.5	0.5
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	5	21.4	0.7	3	24.0	2.1	8	22.4	1.0

Table 3-7-150 Average live weights (gm) for adult *Peromyscus truei* (piñon mouse) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	1	25.0		2	26.5	0.5	3	26.0	0.6
C	Pinyon-juniper (north slope)	2	21.0	1.0	2	27.5	3.5	4	24.3	2.4
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	3	22.3	1.5	4	27.0	1.5	7	25.0	1.3

Table 3-7-151 Average live weights (gm) for adult *Peromyscus truei* (piñon mouse) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	4	17.3	0.9	1	22.0		5	18.2	1.2
C	Pinyon-juniper (north slope)	0			1	20.0		1	20.0	
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	4	17.3	0.9	2	21.0	1.0	6	18.5	1.0

Table 3-7-152 Summary of trapping results for Neotoma cinerea (bushy-tailed wood rat) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.75	71.4	0.00	1.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.15	14.3	1.00	0.00	0.00	0.00
D	Sagebrush	0.15	14.3	0.00	1.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-153 Summary of trapping results for Neotoma cinerea (bushy-tailed wood rat) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.45	100.0	0.33	0.67	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-154 Summary of trapping results for Neotoma cinerea (bushy-tailed wood rat) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	1.50	83.3	0.40	0.00	0.20	0.40
C	Pinyon-juniper (north slope)	0.30	16.7	0.00	0.00	0.50	0.50
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-155 Summary of trapping results for Neotoma cinerea (bushy-tailed wood rat) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.60	44.4	0.25	0.50	0.00	0.25
C	Pinyon-juniper (north slope)	0.45	33.3	0.00	0.67	0.33	0.00
D	Sagebrush	0.30	22.2	0.00	1.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-156 Average live weights (gm) for adult *Neotoma cinerea* (bushy-tailed wood rat) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			2	194.5	13.5	2	194.5	13.5
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	0			2	194.5	13.5	2	194.5	13.5

Table 3-7-157 Average live weights (gm) for adult *Neotoma cinerea* (bushy-tailed wood rat) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	3	177.7	18.2	0			3	177.7	18.2
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	3	177.7	18.2	0			3	177.7	18.2

Table 3-7-158 Average live weights (gm) for adult Neotoma cinerea (bushy-tailed wood rat) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			2	148.5	17.5	2	148.5	17.5
C	Pinyon-juniper (north slope)	0			2	139.0	19.0	2	139.0	19.0
D	Sagebrush	0			1	196.0		1	196.0	
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	0			5	154.2	13.4	5	154.2	13.4

Table 3-7-159 Summary of trapping results for Clethrionomys gapperi (red-backed vole) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Proportion Captured Adult F	Proportion Captured Juvenile M	Proportion Captured Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.30	3.7	0.00	1.00	0.00	0.00
F	Douglas fir	7.76	96.3	0.47	0.53	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours

** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-160 Summary of trapping results for *Clethrionomys gapperi* (red-backed vole) on all small mammal grids during sample period 2, December 7-12, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Proportion Captured Adult F	Proportion Captured Juvenile M	Proportion Captured Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	7.27	100.0	-	-	-	-

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100
- Positive sex identification could not be made in the field

Table 3-7-161 Summary of trapping results for Clethrionomys gapperi (red-backed vole) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Proportion Captured Adult F	Proportion Captured Juvenile M	Proportion Captured Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	5.57	51.5	0.53	0.47	0.00	0.00
G	Aspen	5.25	48.5	0.44	0.56	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-162 Summary of trapping results for *Clethrionomys gapperi* (red-backed vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	3.61	40.7	0.18	0.82	0.00	0.00
G	Aspen	5.25	59.3	0.25	0.50	0.19	0.06

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-163 Summary of trapping results for Clethrionomys gapperi (red-backed vole) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured: Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	1.64	27.8	0.20	0.60	0.20	0.00
G	Aspen	4.26	72.2	-	-	-	-

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100
\- Positive sex identification could not be made in the field

Table 3-7-164 Jolly-Seber population density estimates for Cleithrionomys gapperi (red-backed vole) at grid G, aspen, after each trap night for RBOSP

i	a	p	M	N	#/ha	var(N/N)	B	var(B)	0	var(0)
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-
11	0.000	*	0.0	*	*	*	*	*	0.500	0.208
12	0.000	*	1.5	*	*	*	38.0	*	2.000	3.333
13	0.250	0.111	9.0	36.0	*	2016.0	*	*	0.500	0.312
14	0.000	*	6.0	*	*	*	*	*	*	*
15	0.000	*	*	*	*	*	15.5	*	1.500	*
16	0.429	0.500	6.0	14.0	*	67.7	*	*	*	*
17	1.000	*	*	*	*	*	*	*	*	*
18	0.000	*	*	*	*	*	*	*	*	*
19	0.200	0.167	6.0	30.0	*	1600.0	*	*	*	*
20	0.250	*	*	*	*	*	*	*	0.500	*
21	0.000	*	1.0	*	*	*	*	*	*	*
22	0.000	*	*	*	*	*	*	*	*	*
23	0.500	*	*	*	*	*	*	*	*	*
24	0.400	1.000	2.0	5.0	*	0.0	*	*	*	*
25	0.333	*	*	*	*	*	*	*	*	*

* Recapture data are insufficient to permit computation
\- Grid not sampled

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Table 3-7-166 Average extended range length (m) for adult Clethrionomys gapperi (red-backed vole) on small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	1	69.9		1	52.5		2	61.2	8.7
	SUMMARY--ALL GRIDS	1	69.9		1	52.5		2	61.2	8.7

Table 3-7-167 Average extended range length (m) for adult Clethrionomys gapperi (red-backed vole) on small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	1	56.0		0			1	56.0	
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	56.0		0			1	56.0	

Table 3-7-168 Average extended range length (m) for adult *Clethrionomys gapperi* (red-backed vole) on small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			1	56.0		1	56.0	
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	0			1	56.0		1	56.0	

Table 3-7-169 Average live weights (gm) for adult *Clethrionomys gapperi* (red-backed vole) on all small mammal grids during sample period 5, May 18-26, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	8	21.4	0.8	8	19.1	1.2	16	20.3	0.8
G	Aspen	7	17.7	1.0	9	18.1	1.2	16	17.9	0.8
	SUMMARY--ALL GRIDS	15	19.7	0.8	17	18.6	0.8	32	19.1	0.6

Table 3-7-170 Average live weights (gm) for adult *Clethrionomys gapperi* (red-backed vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	2	16.5	5.5	9	22.3	1.4	11	21.3	1.6
G	Aspen	4	18.5	2.2	8	25.1	2.2	12	22.9	1.9
	SUMMARY--ALL GRIDS	6	17.8	2.0	17	23.6	1.3	23	22.1	1.2

Table 3-7-171 Average live weights (gm) for adult *Clethrionomys gapperi* (red-backed vole) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	1	11.0		3	17.7	3.4	4	16.0	2.9
G	Aspen	4	13.8	0.9	5	12.6	0.7	9	13.1	0.6
	SUMMARY--ALL GRIDS	5	13.2	0.9	8	14.5	1.5	13	14.0	1.0

Table 3-7-172 Summary of trapping results for <u>Microtus montanus</u> (montane vole) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.15	100.0	1.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-173 Summary of trapping results for Microtus montanus (montane vole) on all small mammal grids during sample period 2, December 7-12, 1974, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	2.42	80.0	0.50	0.50	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.61	20.0	0.00	1.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-174 Summary of trapping results for <u>Microtus montanus</u> (montane vole) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	F	Juvenile M	F
1	Bottomland meadow	1.21	100.0	0.50	0.50	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-175 Summary of trapping results for Microtus montanus (montane vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	1.01	87.0	0.00	1.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.15	13.0	1.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-176 Average live weights (gm) for adult *Microtus montanus* (montane vole) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	1	29.0		1	30.0		2	29.5	0.5
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	29.0		1	30.0		2	29.5	0.5

Table 3-7-177 Average live weights (gm) for adult *Microtus montanus* (montane vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	1	18.0		0			1	18.0	
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	18.0		0			1	18.0	

Table 3-7-178 Summary of trapping results for *Microtus longicaudus* (long-tailed vole) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.61	21.2	1.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	2.26	78.8	0.80	0.20	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-179 Summary of trapping results for <u>Microtus longicaudus</u> (long-tailed vole) on all small mammal grids during sample period 2, December 7-12, 1974, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	2.42	40.0	0.50	0.50	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	3.64	60.0	0.83	0.17	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-180 Summary of trapping results for Microtus longicaudus (long-tailed vole) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Proportion Captured Adult F	Proportion Captured Juvenile M	Proportion Captured Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.30	100.0	1.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours

** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-131 Summary of trapping results for <u>Microtus longicaudus</u> (long-tailed vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.15	50.0	0.00	1.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.15	50.0	0.00	1.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-182 Summary of trapping results for *Microtus longicaudus* (long-tailed vole) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured Per 100 Trap Nights *	Relative Abundance **	Proportion Captured Adult M	Proportion Captured Adult F	Proportion Captured Juvenile M	Proportion Captured Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.61	16.3	0.00	0.00	1.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	1.50	40.4	-	-	-	-
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.30	8.1	1.00	0.00	0.00	0.00
F	Douglas fir	0.33	8.8	0.00	1.00	0.00	0.00
G	Aspen	0.98	26.4	1.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100
\- Positive sex identification could not be made in the field

Table 3-7-183 Average live weights (gm) for adult *Microtus longicaudus* (long-tailed vole) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	2	23.5	5.5	0			2	23.5	5.5
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	2	23.5	5.5	0			2	23.5	5.5

Table 3-7-134 Average live weights (gm) for adult *Microtus longicaudus* (long-tailed vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			1	23.0		1	23.0	
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			1	29.0		1	29.0	
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	0			2	26.0	3.0	2	26.0	3.0

Table 3-7-185 Average live weights (gm) for adult Microtus longicaudus (long-tailed vole) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	1	26.0		3	21.3	0.3	4	22.5	1.2
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	2	15.5	2.5	0			2	15.5	2.5
F	Douglas fir	0			1	22.0		1	22.0	
G	Aspen	3	17.0	0.6	0			3	17.0	0.6
	SUMMARY--ALL GRIDS	6	18.0	1.8	4	21.5	0.3	10	19.4	1.2

Table 3-7-186 Percent diet composition for long-tailed voles (*Microtus longicaudus*) collected from major vegetation types during December, 1974 and May, July and October, 1975 for RBOSP

Habitat/Sampling period	Sample Size	Food categories (% composition) Seed	Succulent	Invertebrates	Vertebrates
Greasewood-Sagebrush					
No individuals captured					
Pinyon-juniper (south slope)					
No individuals captured					
Pinyon-juniper (north slope)					
No individuals captured					
Sagebrush					
No individuals captured					
Mixed Brush					
No individuals captured					
Aspen					
December, 1974	0				
May, 1975	4	96	3	1	0
July, 1975	5	6	94	0	0
October, 1975	4	12	88	0	1
Total	13	Average 36	64	0	0

Table 3-7-187 Summary of trapping results for Lagurus curtatus (sagebrush vole) on all small mammal grids during sample period 1, October 19-24, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	1.21	61.7	0.50	0.50	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.45	23.0	0.33	0.67	0.00	0.00
E	Mixed brush	0.30	15.3	0.50	0.50	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-138 Summary of trapping results for Lagurus curtatus (sagebrush vole) on all small mammal grids during sample period 2, December 7-12, 1974, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	F	Juvenile M	F
1	Bottomland meadow	1.82	50.0	0.67	0.33	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.61	16.7	1.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	1.21	33.3	1.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-189 Summary of trapping results for Lagurus curtatus (sagebrush vole) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Proportion Captured Adult F	Proportion Captured Juvenile M	Proportion Captured Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.30	28.6	0.50	0.50	0.00	0.00
E	Mixed brush	0.75	71.4	0.40	0.60	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-190 Summary of trapping results for Lagurus curtatus (sagebrush vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	# Individuals Captured * Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.15	33.3	0.00	1.00	0.00	0.00
E	Mixed brush	0.30	66.7	0.50	0.50	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-191 Summary of trapping results for Lagurus curtatus (sagebrush vole) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.30	40.0	1.00	0.00	0.00	0.00
E	Mixed brush	0.45	60.0	0.33	0.67	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-192 Average live weights (gm) for adult *Lagurus curtatus* (sagebrush vole) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	1	17.0		1	20.0		2	18.5	1.5
E	Mixed brush	1	17.0		3	21.7	1.2	4	20.5	1.4
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	2	17.0	0.0	4	21.3	0.9	6	19.8	1.1

Table 3-7-193 Average live weights (gm) for adult Lagurus curtatus (sagebrush vole) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			1	20.0		1	20.0	
E	Mixed brush	1	17.0		1	22.0		2	19.5	2.5
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	17.0		2	21.0	1.0	3	19.7	1.5

Table 3-7-194 Average live weights (gm) for adult Lagurus curtatus (sagebrush vole) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	2	16.5	3.5	0			2	16.5	3.5
E	Mixed brush	1	19.0		2	18.5	1.5	3	18.7	0.9
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	3	17.3	2.2	2	18.5	1.5	5	17.8	1.3

Table 3-7-195 Summary of trapping results for <u>Perognathus apache</u> (apache pocket mouse) on all small mammal grids during sample period 5, May 18-26, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	1.21	100.0	1.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-196 Summary of trapping results for Perognathus apache (apache pocket mouse) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.61	50.0	1.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.61	50.0	0.00	1.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.00	0.0	0.00	0.00	0.00	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours

** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-197 Summary of trapping results for Perognathus apache (apache pocket mouse) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	* # Individuals Captured Per 100 Trap Nights	** Relative Abundance	Proportion Captured Adult M	Adult F	Juvenile M	Juvenile F
1	Bottomland meadow	0.00	0.0	0.00	0.00	0.00	0.00
2	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
3	Rabbitbrush	0.00	0.0	0.00	0.00	0.00	0.00
4	Pinyon-juniper/mixed brush	0.61	36.5	0.00	0.00	1.00	0.00
5	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
6	Pinyon-juniper/sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
7	Upland meadow	0.00	0.0	0.00	0.00	0.00	0.00
A	Greasewood-sagebrush	0.30	18.1	0.00	1.00	0.00	0.00
B	Pinyon-juniper (south slope)	0.75	45.3	0.00	0.80	0.20	0.00
C	Pinyon-juniper (north slope)	0.00	0.0	0.00	0.00	0.00	0.00
D	Sagebrush	0.00	0.0	0.00	0.00	0.00	0.00
E	Mixed brush	0.00	0.0	0.00	0.00	0.00	0.00
F	Douglas fir	0.00	0.0	0.00	0.00	0.00	0.00
G	Aspen	0.00	0.0	0.00	0.00	0.00	0.00

* 1 trap night = one trap baited and set for 24 hours
** (# of individuals of each species / # of individuals of all species) X 100

Table 3-7-198 Average live weights (gm) for adult *Perognathus apache* (apache pocket mouse) on all small mammal grids during sample period 3, May 18-26, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	2	14.0	1.0	0			2	14.0	1.0
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	2	14.0	1.0	0			2	14.0	1.0

Table 3-7-199 Average live weights (gm) for adult *Perognathus apache* (apache pocket mouse) on all small mammal grids during sample period 4, July 25-30, 1975, for RBOSP

		MALE			FEMALE			ALL ADULTS		
Grid	Vegetation type	n	Average	Std. Error	n	Average	Std. Error	n	Average	Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	1	13.0		0			1	13.0	
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			1	10.0		1	10.0	
A	Greasewood-sagebrush	0			0			0		
B	Pinyon-juniper (south slope)	0			0			0		
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	1	13.0		1	10.0		2	11.5	1.5

Table 3-7-200 Average live weights (gm) for adult *Perognathus apache* (apache pocket mouse) on all small mammal grids during sample period 5, Sept. 31-Oct. 4, 1975, for RBOSP

Grid	Vegetation type	MALE n	MALE Average	MALE Std. Error	FEMALE n	FEMALE Average	FEMALE Std. Error	ALL ADULTS n	ALL ADULTS Average	ALL ADULTS Std. Error
1	Bottomland meadow	0			0			0		
2	Sagebrush	0			0			0		
3	Rabbitbrush	0			0			0		
4	Pinyon-juniper/mixed brush	0			0			0		
5	Mixed brush	0			0			0		
6	Pinyon-juniper/sagebrush	0			0			0		
7	Upland meadow	0			0			0		
A	Greasewood-sagebrush	0			2	9.0	1.0	2	9.0	1.0
B	Pinyon-juniper (south slope)	0			3	9.3	0.9	3	9.3	0.9
C	Pinyon-juniper (north slope)	0			0			0		
D	Sagebrush	0			0			0		
E	Mixed brush	0			0			0		
F	Douglas fir	0			0			0		
G	Aspen	0			0			0		
	SUMMARY--ALL GRIDS	0			5	9.2	0.6	5	9.2	0.6

B. Large Mammals

1. Objectives - Large mammal investigations are designed to determine the distribution and relative abundance of mule deer, elk, and feral horses in the vicinity of Tract C-a on a seasonal basis. Investigations are also being conducted to determine relative use of portions of the study area during seasonal movements of mule deer. The purpose of this report is to present, summarize, and interpret data gathered between October, 1974 and October, 1975.

2. Methods

a. Data Collection - Several methods have been and are being employed to determine large mammal use of the area. Aerial surveys are being conducted periodically throughout the year for all large mammal species. Pellet group counts are being employed to aid the evaluation of mule deer use of the area. During periods when seasonal movements of mule deer are occurring, aerial surveys and track counts are being conducted. Sex and age ratio counts were conducted after the 1974 deer hunting season. General field observations are also recorded during field activities. Literature pertinent to the Piceance Basin was surveyed and new information is reviewed as it becomes available. Procedures have been described in the First Quarterly Data Report (Ecology Consultants, Inc., 1975a) and modifications of the procedures have been detailed in the Third and Fourth Quarterly Data Reports (Ecology Consultants, Inc., 1975b, 1975c). A summary of the procedures, incorporating all such modifications since the original study plan, is given below.

1) Aerial Surveys - Aerial censuses being conducted to determine relative distributional abundance of mule deer, elk, and feral horses on Tract C-a and surrounding areas employ a high-wing Cessna aircraft designed to permit slow flight at low levels above the ground. The plane is flown along standardized transects (flight paths) within the range of 120-136 km (75-85 mi) per hour (indicated air speed) at an altitude of approximately 45.7 m (150 ft) above the ground. Due to the varied topography, the above-ground altitude varies slightly within transects; however, the flight paths, speed, and altitude of the aircraft are duplicated as much as weather conditions permit.

Weather conditions are of such a variable nature that perfect flight conditions are not possible for every flight. At times, the weather may postpone a flight or terminate a census that is in progress. The observer makes a decision if the census is to be conducted or continued after consultation with the pilot concerning the limitations on flight caused by the weather. The decision is based on considerations for safety of the observers and the effectiveness of the survey. The level of effectiveness of the survey is a judgment made by the observer based on past experience in conducting censuses. If a flight is postponed or not completed, it is conducted in its entirety when weather conditions become more favorable.

Census flights are conducted at approximately two-week intervals from late October through early April to assess the mule deer populations during the winter period. Flights conducted bimonthly during the summer months are intended mainly for elk and feral horse observations,although all species of animals observed during each census flight are recorded.

Complete coverage of the area of investigation is accomplished by 19 north-south transects. The flight paths parallel each other at approximately 0.81 km (0.5 mi) intervals east of Tract C-a and 1.6 km (1.0 mi) intervals on Tract C-a and to its west (Figure 3-7-36). More intensive coverage is applied to the east of the tract since Baker (1970) identifies this region as a major mule deer winter concentration area.

The aerial censuses conducted to the east of Tract C-a survey an area of approximately 16.1 km (10.0 mi) by 8.9 km (5.5 mi). The boundaries of the area are Duck Creek on the north, a line running north and south approximately 0.5 mi east of Duckett Ranch on the east, Duckett Ranch on the south, and the eastern boundary of Tract C-a on the west.

The remaining eight transects survey an area of approximately 16.1 km (10.0 mi) by 12.1 km (7.5 mi). The boundaries of this area on the north and south are extensions of the northern and southern boundaries of the area east of the tract. The eastern-most transect is located along the eastern boundary of the tract while the western-most transect is along the north-south section lines immediately east of Cathedral bluffs.

The preceding describes transects flown for the program during and since June, 1975. Flights conducted for winter counts for mule deer from October, 1974 through April, 1975 covered the study area in four separate but adjacent census areas, while elk and feral horse counts were conducted less intensively over a wider area. The mule deer, elk, and feral horse counts were combined and modified as described in the preceding paragraph to standardize the aerial survey program. A description of each census area surveyed is included below, and these areas are described in the order in which they were sampled during each survey flight.

The first area sampled was Tract C-a where eight transects were flown (Figure 3-7-37). The northern boundary was delineated by the ridge above Dry Fork of Corral Gulch, while the eastern, southern, and western boundaries were delineated by the respective tract boundaries. The first transect commenced at the northwest corner of the census area. Odd-numbered transects were flown from north to south; even-numbered transects were flown in the opposite direction. Each successive flight pass was flown approximately 0.53 km (0.33 mi) east of the previous transect. An area north of Tract C-a on 84 Mesa was surveyed by extensions of transects 4 through 8 northward to Duck Creek. Sampling began on this area during the February counts, after ECI became aware that 84 Mesa was being considered as a potential processed-shale disposal site. This north census area was considered as the second census area.

The East Census Area was sampled by 11 north-south transects spaced at approximately 0.81 km (0.5 mi) intervals. Such spacing permitted coverage of a large area to locate deer concentrations. The boundaries of the area were Duck Creek on the north, a line running south from a point approximately 0.40 km (0.25 mi) upstream from the confluence of Duck Creek and Yellow Creek on the east, Duckett Ranch on the south, and the eastern boundary of Tract C-a on the west. Transect 1 commenced on the northeast corner of the census area; each successive transect was west of the preceding pass.

The fourth area sampled was located west of Tract C-a. Four north-south transects commencing on the southwest corner, successively located approximately 0.81 km east, were flown within the following boundaries: north fork of Big

Duck Creek on the north; western edge of Tract C-a on the east; the road in Section 19, T2S, R99W on the south; and the section line 1 mi west of the eastern R100W boundary on the west.

The West Census Area, at a higher elevation than the East Census Area, had greater snow accumulations during the winter period. During the period when mule deer winter counts were flown on the census areas described above, elk and feral horse counts were conducted at bimonthly intervals over the transects shown in Figure 3-7-37 . Elk and feral horses were recorded, however, whenever they were observed during the mule deer winter counts. The modification of the program which took place in June, 1975, served to standardize the counts so that the same transects are flown for each survey and all large mammals observed are counted and recorded.

To permit constant observation of the transect area along the flight paths, portable tape recorders are used to record information during the survey. All animals seen by the pilot and two observers (positioned on opposite sides of the plane) are identified to species, counted, and their locations noted. The observers communicate with each other and the pilot when necessary to confirm the location of animals observed. When possible, information on age, sex, activity patterns, and habitat is also recorded on the cassette tape. Immediately before the censuses commence, each observer identifies the category of data to be recorded (e.g., Large Mammal Aerial Census), the date, area to be surveyed, observer's name and observation position in the aircraft, the name and position of the other observer, name of pilot, and aircraft's make and model on the tape. Weather conditions such as temperature, estimated wind speed and direction, and estimated cloud cover are also recorded. The time is recorded at the beginning of the first transect and at the end of the last transect for the census area. General impressions on animal distribution, ground cover characteristics, changing weather conditions, light and spotting conditions, and flight characteristics are recorded at appropriate times throughout the census flight. Other species of animals (such as coyotes) observed incidentally during the aerial surveys are also noted to aid in the evaluation of the distribution of these species.

The information recorded on the tape is transferred by each observer from a transcript onto a standard data form (Figure 3-7-38). Distribution maps showing locations of the animals observed are generated at the same time. Incidental observations are recorded on Field Observation Sheets (Figure 3-7-39). The procedure described above is completed as soon as possible upon completion of the census flight. If circumstances should occur which cause a delay of over 14 days or if another flight is conducted before the data are recorded on the data forms and distribution maps, the analyst notes such a delay on the forms and map.

2) Mule Deer Sex and Age Ratios - To provide data on the relative sex and age structure of the mule deer population occurring on Tract C-a and surrounding areas, an aerial helicopter survey was conducted during December, 1974 to determine sex and age classes. During the flight, one observer and the helicopter pilot systematically searched Tract C-a and adjacent areas for mule deer. Age, sex, and location of deer were recorded on a cassette tape. Other pertinent information, such as date, observer's name, weather conditions, etc., was recorded in the same manner as during the mule deer winter counts. The data were later transcribed on the standard data form (Figure 3-7-38) under the same constraints as described for the mule deer winter counts.

Specific techniques for designating age classes were discussed with Mr. Richard Bartmann, Colorado Division of Wildlife, Little Hills Experiment Station. Deer observed were classified as fawns, bucks, or does. The helicopter sex and age counts also aided in the determination of relative distributional abundance within the study area.

Tract C-a, the West Census Area, Stake Springs Draw, and 84 Mesa were intensively searched during the helicopter survey. The helicopter was flown in a zig-zag pattern along topographic features in a manner that assured effective coverage of the study area. When deer were spotted, the pilot and observer worked as a team to count and classify the animals accurately.

3) Mule Deer Migration Movement Study - Repetitive observations during the period when migration is occurring are used to determine relative

levels of use of areas in the vicinity of Tract C-a. Visual observations are made from a fixed-wing aircraft during each of the movement periods in spring 1975, fall 1975, and spring 1976. Weather permitting, seven observational flights are conducted every other day for a 2-week period during each of these times. The timing of the sequence of flights will attempt to encompass the time of greatest movement activity. To a considerable extent, this activity is dependent on weather conditions. Monitoring of the weather conditions coupled with estimated times of migratory activity and coordination with biologists at Little Hills Experiment Station aid in determining the date on which to initiate the flights. The procedures described for mule deer winter counts are used during the flights for the migration movement study with the exception that the pilot serves as the second observer on the migration aerial surveys.

A total of 13 north-south transects is used to survey the area during the aerial counts (Figure 3-7-40). The transects, spaced at 1.61 km (1 mi) intervals, are approximately 16.1 km (10 mi) to 17.7 km (11 mi) in length. The census area extends approximately 8.1 km (5 mi) east of Tract C-a boundaries (along the second flight line used during the winter counts) and to the ridge along Cathedral Bluffs west of Tract C-a.

If certain areas appear to have substantial mule deer activity, the specific areas may, at the discretion of the observer, be surveyed more intensively upon completion of the transects described above. Procedures for this more intensive survey, if desirable, are formulated by the observer based on the circumstances.

Track counts along dirt roads east of Tract C-a are used to supplement the aerial census program to determine mule deer migration movement patterns. Methods used employ modifications of work done by Wright and Swift (1942). The road shown on Figure 3-7-40 is dragged to eliminate existing tracks. The road is examined every other day for the two week period that the flights for migration movement investigations are conducted. A record of crossing locations, direction of travel, and number of tracks is made on a standard data sheet (Figure 3-7-41). All new tracks observed are obliterated after each inspection.

4) Mule Deer Pellet Group Counts - Pellet group counts have been used by many researchers to census big game, indicate population trends, and determine distribution patterns of big game animals (Bennet, English, and McCain, 1940; Riney, 1957; Julander, 1958; Harris, 1959). The technique involves counting the number of pellet groups deposited during a known time period on an area of known size. This information, coupled with a knowledge of big game defecation rates, can be used to compute the levels of deer use in an area. Several researchers have published defecation rates and other pertinent information on study design, techniques, and field procedures for big game studies (Rogers, Julander, and Robinette, 1958; Smith, 1964; McKean, 1965; and Neff, 1968). Sampling intensities required to produce acceptable population estimates vary according to density of pellet groups, size of area to be sampled, desired accuracy, and many other factors. Most previous studies have indicated the need for a large sample size, even in areas of high deer density and where relatively broad confidence limits on the estimate are acceptable.

To provide an estimate of relative use of various sections in the area of investigation, 13 pellet-group count transects were established in the vicinity of Tract C-a. Nine transects were established off Tract C-a in potential mule deer summer range, and four transects were established on Tract C-a (Figure 3-7-36).

Pellet group sampling sites were randomly selected from possible transects plotted on a topographic map, oriented so they cross contour lines Orientation in this manner sampled a large number of different aspects, slopes, and vegetation types. A table of random numbers was used to select the transect locations to be established from among the possibilities.

A map showing the selected transect locations was used in the field during the pellet group count transect establishment. Compasses were used to orient the transects in the proper direction and to check the transect location relative to distinctive land forms.

Each transect consists of 25, 9.3 m^2 (100 sq ft) circular plots spaced at 76.2 m (250 ft) intervals along a straight line course. During transect establishment,

a 45.7 cm (18 in) rebar stake was driven into the ground to mark the center of each plot. The distance between plots on the transect was measured with a tape measure along a compass course. An aluminum pole, slipped over the rebar stake, serves as an axis for a rope marked 1.72 m (5.64 ft) from the center of the stake. When the rope is revolved around the pole, the mark delineates the plot boundaries. A short written description of vegetation and landforms was recorded for each plot during transect establishment. This description is amended during later examination periods to include notes on disturbance and seasonal vegetation patterns.

All old pellets were cleared from the plots during the establishment phase. Plots were inspected visually, in two sections clockwise and once counterclockwise, to assure that all groups were located. Each group observed was removed until the plot had been completely cleared. The procedure was repeated for each plot. Clearing all old pellet groups during the initial transect work established a definite period of pellet group accumulation to be used in calculations.

The plots on Tract C-a which were cleared during establishment were inspected during spring, 1975. Pellet groups deposited during the 1974-1975 winter period were counted, removed, and recorded on field data sheets (Figure 3-7-42). Inspections of the plots are done in the same manner as described for plot clearing procedures. To qualify for recording, a pellet group must consist of at least five pellets exhibiting the same general shape, color, and consistency. Groups on the edge of a plot are counted only if at least half of the pellets are within the plot boundaries. Pellet groups deposited during summer, 1975 were counted and removed during September of that year.

b. Data Analysis

1) Mule Deer Pellet Group Counts - The number of mule deer pellet groups per acre is determined by multiplying the total number of groups observed on the 25 plots per transect by 7.42 (43.01 for determining groups per hectare). The number of groups per acre divided by the number of days in the accumulation period yields a pellet group index. Pellet group density estimates

can be used directly as indications of population trends between years or between areas without consideration of defecation rate, assuming the defecation rates are similar in all years and areas (Neff, 1968).

After the summer, 1975 inspection of the plots, data were analyzed to determine if changes in sampling intensity are necessary to achieve the sampling accuracy desired to meet the ojbectives of the study. The following formula (Grieb 1958 in Neff, 1968) was used to determine the sample size necessary to give a desired sampling accuracy:

$$N = \frac{(t_{0.10})^2 s^2}{(d\ \overline{x})^2}$$

Where:

- N = number of plots required
- s^2 = variance of the preliminary sample data
- $\overline{x}$ = mean of the preliminary sample data
- d = selected risk of errors (e.g., if the estimate is expected to fall within 20% of the mean 90 times out of 100, use 0.20 at d)
- t = tabular value for the selected levels of probability

An evaluation of the pellet group program based on what has been learned about summer use of the area, results of the calculation described above, and the objectives of the big game study will be made. This evaluation will consider continuation of the program at its present intensity, expansion of the program, or deletion of the program in favor of other techniques such as strip census.

3. Data Summary

a) Aerial Surveys - Two flights were conducted each month from November, 1974 through April, 1975 with the exception of January, 1975, when only one flight was completed. One distribution map is shown for each month's surveys in Figures 3-7-43 through 3-7-48.

The numbers of mule deer observed on four census areas during aerial surveys conducted from November, 1974 through April, 1975 are presented in Table 3-7-203.

Mule deer were not observed in surveys conducted during June and August on the combined mule deer, elk, and feral horse counts.

As stated in previous reports (Ecology Consultants, Inc., 1975), varied backgrounds, animal habits, weather, and spotting conditions preclude the observation of all animals within a census area so the figures given do not represent the absolute number of animals present on the area during the survey periods. Gilbert and Grieb (1957) reported that an observer could consistently count a certain percentage of mule deer present in an area for a specific set of spotting conditions. Smaller percentages of the deer present were counted in surveys conducted when there were relatively poor spotting conditions. Spotting conditions rely on several factors including the amount of turbulence affecting the airplane, light intensity and direction, and characteristics of the background such as presence or absence of snow. Gilbert and Grieb (1957) reported that with excellent snow conditions, an average of 49% of the total deer present were counted, while an average of only 45% and 34% were counted during good and poor to fair conditions, respectively, when air and ground deer counts were compared. For the purposes of this study, spotting conditions from poor to excellent are defined as follows: excellent counting conditions are experienced when the entire area is completely covered by snow and the sky is clear; poor conditions are experienced when snow cover is sparse and the sky is cloudy; good and fair counting conditions range between the excellent to poor counting conditions and are based on the relative amount of snow cover and cloud cover.

Mule deer were observed in small groups scattered throughout the census areas during the November surveys, which were conducted during poor to fair spotting conditions. The deer were observed in the mixed brush and sagebrush vegetation types on the West Census Area; in mixed brush, sagebrush, and pinyon-juniper vegetation types on Tract C-a; and most frequently in the pinyon-juniper vegetation type on the East Census Area.

The first survey in December was conducted during fair spotting conditions, but the second survey took place during excellent spotting conditions. The number of mule deer observed during this period exceeded the number observed during

the November surveys, and the size of the individual groups of deer spotted also increased. Relatively large numbers of deer were observed in the mixed brush vegetation type on the West Census Area during the December period, particularly during the second survey of the month. The West Census Area was intensively surveyed with a helicopter three days before the December 30, 1975 survey and few deer were observed at that time, possibly indicating a rapid change in level of deer use within the study area. Several herds of deer were scattered within the pinyon-juniper and sagebrush vegetation types occurring on Tract C-a. The deer observed on the East Census Area were occupying the small gullies along the larger gulches and creeks.

Excellent to good spotting conditions were recorded on the January survey, but fewer deer were observed on all census areas compared to the December counts. The deer observed on the West Census Area were located in mixed brush and sagebrush vegetation types occupying the south-facing slopes of Dead Horse Ridge. Small groups of mule deer were observed on north-facing slopes and gully bottoms as well as on the south-facing slopes of Tract C-a. Deer were generally scattered throughout the East Census Area.

Excellent spotting conditions were experienced during the first survey conducted in February, 1975, but only fair spotting conditions were present during the second flight. The February survey flights over the West Census Area revealed very little deer activity; only two mule deer were observed and large portions of the area were covered by undisturbed, trackless snow. Deer observed on Tract C-a were on the south-facing slopes above Dry Fork and on the ridge between Corral Gulch and Box Elder Gulch. The majority of the animals observed on Tract C-a during this period were in pinyon-juniper vegetation types, and the remainder were located in the sagebrush vegetation type. A similar distribution of mule deer among vegetation types was noted on the East Census Area with observations in the pinyon-juniper type occurring more frequently than in any of the other vegetation types. Mule deer were concentrating in the small gullies and slopes near Yellow Creek in the northeast portion of the census area with other small herds scattered along Stake Springs Draw and Ryan Gulch. A survey of the area north of Tract C-a was initiated during February, 1975. Small herds of deer were observed scattered throughout the pinyon-juniper vegetation type in the North Census Area.

Deer were not observed on the West Census Area during the March surveys; few deer were observed on Tract C-a, but more deer were observed on the East Census Area than during previous surveys. Poor spotting conditions were experienced during the March surveys due to lack of fresh snow. The majority of the animals observed on Tract C-a were scattered along the ridge between Corral Gulch and Box Elder Gulch. Deer on the East Census Area appeared to be using the sagebrush vegetation type more heavily than in previous months. Most of the deer were concentrated in the sections comprising the northeast quarter of the census area. In the North Census Area the pinyon-juniper vegetation type appeared to be used more heavily than the other vegetation types during this period.

Poor and excellent spotting conditions were experienced for the April surveys. Few mule deer were observed on the West Census Area during this period. The mule deer observed on Tract C-a were between Corral Gulch and Box Elder Gulch, primarily in the pinyon-juniper vegetation type. Large herds of deer were observed in all sections of the East Census Area except those comprising the southwest quarter. The pinyon-juniper and sagebrush-covered areas north of Black Sulfur Creek and Ryan Gulch each had several groups of deer, but the largest concentration of deer was observed in the meadows along Corral Gulch and Yellow Creek. Deer appeared to be dispersing from the concentration area on the northeast portion of the East Census Area across 84 Mesa north of Tract C-a.

The distribution and relative number of mule deer observed during the 1974-1975 surveys suggest that animal movement and distribution changes occurred in the study area throughout the winter. The general distribution pattern observed during the 1974-1975 winter was characterized by a few, small, widely-scattered groups throughout the area during the first part of the winter. Greater numbers of mule deer then concentrated into larger herds during December, 1974. A decrease in the number of deer was observed in early 1975. Concentrations of deer generally moved from the west to the east within the study area as winter progressed. Heavy use of the East Census Area continued throughout March and April of 1975. The West Census Area received only light use or no use from January through April, 1975. Mule deer were observed on Tract C-a throughout all surveys. The heaviest use of Tract C-a occurred during December, 1974 through February, 1975.

A small number of elk have been observed on the study area during aerial surveys and general field observations. The location and number of elk observed during October, 1974 through October, 1975 are shown on Figure 3-7-49. Elk were not observed on Tract C-a or in the East Census Area during the past year. Elk observed during the surveys conducted throughout the winter months were generally on windblown ridge tops or south-facing slopes along Cathedral Bluffs, northwest of Tract C-a. Animals south of Tract C-a along Ryan Gulch were observed during April, 1975. Those observed in the gulch bottoms southwest of Tract C-a were observed during the summer months.

Feral horse herds are common on the study area throughout the year. The number of horses observed during the six aerial elk and feral horse surveys conducted from October, 1974 through October, 1975 is presented in the table below. Locations of the horses observed during each aerial survey are shown in Figure 3-7-50. A large number of field observations of feral horses has been compiled by ECI personnel conducting other field investigations. This information, in addition to aerial survey data, was used to describe feral horse distribution.

NUMBER OF FERAL HORSES OBSERVED DURING SIX AERIAL SURVEYS CONDUCTED FOR RBOSP FROM OCTOBER, 1974 THROUGH OCTOBER, 1975

	Horses Observed			
Date	Total	Adult	Juvenile	Unidentified
November 8, 1974	108	24	15	69
December 30, 1974	86	8	2	76
March 4, 1975	41	16	4	21
April 14, 1975	74	69	5	0
June 26, 1975	93	69	24	0
August 18, 1975	63	55	8	0

Surveys during November, 1974 revealed that the horses were distributed on the study area in herds of up to 19 individuals. The largest concentration of

horses was observed near the landing strip in Section 9, T2S, R99W. Most of the horses in the study area were observed on ridge tops, although the horses observed on Tract C-a were on the slopes above the bottoms of the gulches. Few horses were observed near the landing strip during December, and the animals appeared to be more widely scattered in areas farther from the tract. Several herds were observed on the windblown ridges on top of Cathedral Bluffs. Poor spotting conditions prevailed during the March surveys. Most of the horses were observed in sheltered areas and no large concentration of animals was evident. The largest herd spotted during March, 1975 was located on 84 Mesa.

The fourth feral horse survey was conducted on April 14, 1975. Most of the horses observed during this period were near Dry Fork and Corral Gulch, although a herd of 15-17 animals was located on the eastern portion of 84 Mesa at this time.

The June survey revealed most of the horses to be south and west of Tract C-a. The largest herds observed during this period were on the ridge between the Right and Left orks of Stake Springs Draw, although numerous animals were observed on Landing Strip Ridge, and in Water Gulch and Corral Gulch.

All of the feral horses observed during the August, 1975 survey were west of Tract C-a. A herd of 26 animals was observed on Landing Strip Ridge and the remaining horses were spotted in herds ranging in size from 5 to 9 individuals. The smaller herds were scattered on the ridge tops between Dead Horse Ridge and Airplane Ridge.

Field observation forms indicate that the herd of horses on Landing Strip Ridge throughout the summer of 1975 was comprised of approximately 30 individuals, which included 21 adults and 9 juveniles. The animals in this herd appeared to range north of Box Elder Gulch and south of Right Fork of Stake Springs Draw as well as along Landing Strip Ridge. The horses in this general area appeared to be members of the largest herd on the study area. Over 50 individuals were observed near the landing strip on November 8, 1974. Observations of feral horses on 84 Mesa during mule deer winter counts and mule deer migration movement studies indicate that the herd fluctuated between 12

and 15 animals. This herd concentrated its winter activities east of the road which crosses 84 Mesa. Horses were not observed east of the road on 84 Mesa during the summer surveys, but herds ranging in size from 3 to 17 animals were observed west of the 84 Mesa road and north of Tract C-a. A small herd of feral horses has also been observed on Wolf Ridge, east of Tract C-a.

The feral horses observed on Tract C-a have generally been located near the boundary of the tract. Few horses have been reported over 0.81 km (0.5 mi) within the tract boundaries and these herds are usually comprised of less than eight individuals. The relatively frequent periods of human activity on the tract may have had an effect on the number and location of horses observed there.

b. Mule Deer Sex and Age Classifications - Mule deer sex and age classification counts were conducted on December 27, 1974 over Tract C-a, the West Census Area, Stake Springs Draw, and 84 Mesa. The count indicated a buck:doe:fawn ratio of 18:100:92 based on the 7 bucks, 40 does, and 37 fawns (84 deer total) classified. Bartmann (1975a) reported a buck:doe:fawn ratio of 18:100:85 on the basis of 2,817 deer classified during post-hunting season 1974 counts conducted by the Colorado Division of Wildlife for the entire Piceance Basin Area.

c. Mule Deer Migration Movement Study - The spring mule deer migration movement study was conducted on April 12-26, 1975. Weather conditions on April 17-18 did not allow a flight to be conducted, so a total of six aerial surveys were conducted during the spring period. The number of mule deer observed during the aerial surveys is presented in Table 3-7-204. A composite distribution map (Figure 3-7-51) was produced from the maps showing the distribution observed during individual surveys. Track counts conducted on the road east of Tract C-a yielded additional information on mule deer movements during this period. The number and general direction of the tracks is presented in Table 3-7-205 and the location of the crossings is shown in Figure 3-7-52.

Larger numbers of mule deer were observed on the eastern portion of the study area during March and early April than were seen in preceding months, so the migration study was initiated in mid-April and continued through late April.

Field observation forms subsequent to the termination of the surveys indicated that herds of deer still frequented the eastern portion of the study area during early May but had dispersed by mid-May. The figures given in Table 3-7-204, therefore, should not be interpreted as the total number of deer moving through the area since it is now evident that deer were moving within the area for an extended period of time.

Large numbers of deer were frequently observed in the bottomlands along Yellow Creek, Ryan Gulch, and Black Sulfur Creek during the morning aerial surveys (Figure 3-7-51). The animals appeared to concentrate in the meadows to feed, but bedded down in the more rugged shrub-covered hillsides nearby. Deer appeared to gradually drift away from the areas of high concentration used during the winter and spring, with small groups or individuals moving independently rather than a large group moving en masse to a summer range. The mule deer on the study area scattered westward during late April. Most portions of Tract C-a and the eastern portion of the area were used, at least by a few deer, during their slow drift toward summer range. Relatively few mule deer were observed west of Tract C-a during the migration survey period. Snow-covered areas were common on the higher elevations west of Tract C-a and the vegetation had not begun to produce new growth as it had on Tract C-a and the area east of Tract C-a. Field observations indicated that deer were in the area west of Tract C-a through most of May.

Much back and forth movement was recorded during the track count survey, possibly due to the proximity of the road to winter range, its location with respect to the daily feeding and bedding areas used during the period, and the meandering movement of the deer to summer ranges. Certain areas along the track count route appeared to be used more heavily than others during the late April survey. The major drainages and associated areas of broken topography appeared to be most heavily used during the movement period. Relatively smaller amounts of use occurred on large, flat, sagebrush-covered areas or on north-facing slopes.

d) Mule Deer Pellet-Group Counts - Pellet-group plots were established on Tract C-a during October 21-24, 1974 and on the areas west of Tract C-a during

May 16-19, 1975. The distribution of pellet-group plots relative to slope gradient, slope aspect, and vegetation type is presented in Figures 3-7-53 through 3-7-55, respectively. The plots on Tract C-a were examined on May 20, 1975; pellet groups accumulated during the 1974-1975 winter were recorded and removed. All plots were re-examined during September 19-22, 1975, and pellet groups accumulated over the 1975 summer were recorded and removed.

The results of the pellet-group plot inspection on Tract C-a after the 1974-75 winter are given in Table 3-7-206, and the results of the inspection of all transects after the 1975 summer are presented in Table 3-7-207. The formula offered by Grieb, 1958 (cited in Neff, 1968), for determining the sample size necessary to produce a desired degree of sampling accuracy was applied to the data obtained from the summer, 1975 accumulation period. The resulting calculation indicated that an additional 83 mule deer pellet-group transects would be required to achieve an acceptably accurate sample which is defined as having a 0.20 selected risk of error at the 90% confidence level (Table 3-7-208).

A comparison of the pellet group index for the over-winter 1974-75 accumulation period (Table 3-7-206) and for the over-summer 1975 accumulation period (for Transects 1, 5, 6, and 7 in Table 3-7-207) on Tract C-a transects indicates the relative levels of deer use on the tract between the two periods. Although the confidence interval is wide for the over-winter period, pellet groups were recorded on all transects with more groups occurring on the eastern transects and fewer groups occurring on the western transects. During the summer period, the transects on Tract C-a did not accumulate a single pellet group. This indicates that the level of deer use on the tract was extremely limited over the summer period.

The transects located off Tract C-a were established in the spring of 1975, therefore, only the summer's data are interpretable and seasonal comparisons are not possible at this time. The data indicate that, in order to estimate mule deer use within 20% of the mean at the 90% confidence level by sampling pellet group accumulation, the intensity of the sampling program would have to be increased over six-fold. The limitations of pellet-group data for estimating relative use of areas, the wide dispersion of mule deer during the summer, and the relatively low intensity of mule deer use of Tract C-a during the summer do not warrant such an increase at this time under the scope of the present studies.

General conclusions concerning mule deer habitat use of the area west of Tract C-a are suggested on the basis of pellet group data which have been gathered. All of the transects except one indicated deer use during the summer months. The transect which dod not reveal deer activity was located south of Tract C-a in pinyon-juniper and sagebrush vegetation types. Ninety-two percent of the total pellet groups recorded after summer, 1975 were located in mixed brush vegetation type, while the remaining groups were recorded in the sagebrush vegetation type (Table 3-7-209). The mixed brush vegetation type occurred on less than half of the plots sampled (Figure 3-7-55).

The relative distribution of the pellet groups recorded after summer, 1975 by slope gradient is presented in Table 3-7-210 and Figure 3-7-56. Forty-two percent of the pellet groups occurred on slopes of 0-10^{o} compared with 21% on slopes of 11-20^{o} and 33% on slopes of 21-30^{o}. Pellet groups were not observed on slopes greater than 41^{o}. The distribution of plots by slope gradients in Figure 3-7-53 indicates that 54% of the plots were located on slopes of 0-10^{o}, 23% on slopes of 11-20^{o}, 16% on slopes of 21-30^{o}, 5% on slopes of 31-40^{o} and 2% on slopes greater than 41^{o}. Thus, it appears that relatively more pellet groups occurred on the slopes of 21-30^{o} than would be expected based on the relative number of plots located in each slope gradient class. The data were not tested for significant differences due to the limited number of pellet groups observed.

The relative distribution by slope aspect of pellet group accumulation over summer, 1975 is presented in Table 3-7-211 and Figure 3-5-57. The number of pellet groups observed was so limited and the groups were distributed over the various aspects in such a manner that any conclusion on the preference for a specific slope aspect would be questionable.

The conclusions which can be drawn from the pellet group data are limited by the low frequency of occurrence of groups on the transects. Scattered summer distribution of mule would not be conducive to large accumulation of pellet groups. The data do indicate certain usage patterns as described above, however, and the major trend supported by field observations is that most of the area's mule deer occupy the mixed brush vegetation type on higher elevations west of Tract C-a during the summer.

4. Discussion - A discussion concerning the large mammal baseline definition of Tract C-a and the surrounding area based on one year of study must take several facts into consideration. Since large mammals, especially deer, usually move in response to environmental stimuli, the increased human activity associated with preparation of the study area for development (drill rigs, road construction and maintenance, installation of base stations and monitoring devices) which was occurring during the first year's study may have had an effect on large mammal activity in the area. How this may have affected the data gathered during the period cannot be determined due to the lack of information on the large mammal distribution before the initial activity period. Since large mammal distribution, particularly mule deer distribution, depends largely on weather and snow conditions, different levels of use of specific areas are observed during mild winters than are observed during relatively severe winters. Population levels and structure of the entire Piceance herd change in response to many factors, some of which are weather, condition of the range, and managed hunting. The following discussion will attempt to characterize large mammal distribution in, and utilization of, the study area based on what has been learned in the past year.

Mule deer use of the area varies seasonally. The general pattern observed during the 1974-75 sampling season was a gradual influx of deer into the vicinity of Tract C-a during October. Migration movement studies were not conducted during the fall/winter period; however, general observations at that time indicated that animals started to move into and through the study area on and near Tract C-a in mid-October. Deer were observed on Tract C-a throughout the winter, and it can be assumed that deer movements in the area continued through the winter period. Deer were essentially absent from the area west of Tract C-a after January, 1975. This pattern probably occurs during most winters based on information gathered on deer distribution by the Colorado Division of Wildlife (Bartmann, 1972, 1973, and 1974). It is generally assumed that a decline in temperature and increase in snow fall initiate fall deer migrations (Richens, 1966; Russell, 1932). The time, rate, and extent of migrations vary with environmental conditions (Richens, 1966). Mule deer move in search of suitable food and shelter, and distribution is often influenced by the distribution of these necessities. Suitable food and shelter may be

present in an area one winter, due to a light snowfall, while the next year the area may be unsuitable due to deep snows. Snow depths greater than 46 to 51 cm (18 to 20 in.) essentially preclude mule deer use of most areas (Loveless, 1967; Gilbert, et al., 1970).

As the winter progressed, the largest concentrations of mule deer were located in the eastern portion of the study area. This area is within the upper elevational boundary of the average winter range line proposed by Baker (1970) for that area of the Piceance Basin. Animals remained in the area east of Tract C-a through the spring. During this period, the deer concentrated in the bottomlands where they foraged on the new growth. Mule deer generally concentrate in specific meadows along the Piceance Creek drainage during spring before moving on to summer range, although they do not concentrate consistently each year (Bartmann, 1972). The movement through the study area and back to summer range was monitored during a portion of the spring 1975 migration movement. The information gathered indicates that this movement takes place over an extended period as the deer disperse from their winter range. The deer appeared to meander through the area and gradually drift to higher elevations as individuals and small groups rather than en masse along a well-defined route. This interpretation agrees with interpretations made in several studies of mule deer migratory behavior in the Piceance Basin and elsewhere in the western United States (Bartmann, 1968; Siglin, 1965; Gruel and Papez, 1963). It is generally postulated that development of green forage and other environmental factors influence the spring migration movement (Russell, 1932; Richens, 1966).

Little mule deer activity was evident on Tract C-a during the summer months. Most of the deer in the study area were west of Tract C-a by late May. The area west of Tract C-a is characterized by mixed brush stands intermingled with sagebrush, pinyon-juniper, and upland meadow vegetation types. This admixture of vegetation seems to be preferred summer range over the more extensive pinyon-juniper vegetation type located on Tract C-a.

Based on the mule deer distribution patterns observed during the 1974-75 study, Tract C-a itself might tentatively be termed transition range and upper winter

range. During a mild winter the vicinity of Tract C-a will be used more extensively than during a severe winter. Migrating mule deer utilize Tract C-a as they move through toward summer or winter range.

The deer in the Tract C-a study area are part of a larger herd called the Piceance Basin Deer Herd. This herd produces a large portion of the deer harvested each year in Colorado. Game Management Unit 22, which encompasses the Piceance Creek area, has been listed among the top ten game management units in the state for the highest number of hunters and largest number of deer harvested for several years (Colorado Division of Game, Fish and Parks, 1971, 1972; Colorado Division of Wildlife, 1973, 1974, 1975). Overwinter mortality attributed to severe winters in the early 1970's decreased the population of the Piceance Creek herd. Winter mortality for the 1973-74 winter was estimated to be 5,320 total dead for the entire Piceance Basin winter range (Bartmann, 1975b). The Colorado Division of Wildlife is presently attempting to manage the population so a large number of deer are available for harvest each year.

The other large mammals observed in the study area include elk and feral horses. Relatively few elk are found in the study area. Scattered elk herds occur west and south of Tract C-a, while no elk have been observed on Tract C-a.

Feral horses utilize portions of the study area throughout the year, and are most frequently observed west of Tract C-a, although herds also occur on both 84 Mesa and Wolf Ridge. The largest herd of horses observed in the study area is frequently located on Landing Strip Ridge. Most of the feral horses observed on Tract C-a have been near the boundaries of the tract, and several observations have recorded herds just outside the tract boundaries. This distributional pattern may be due to the disturbance factors associated with site preparation.

The feral horses appear to prefer windblown ridges during the winter and to range throughout the entire study area during the remaining parts of the year. Fences restrict their movements over certain portions of the study area.

In summary, feral horses and domestic livestock appear to be the only large herbivores present on Tract C-a during the summer period. Mule deer join them during the fall, winter, and spring; but elk have not been observed on Tract C-a and probably rarely, if ever, use the area within its boundaries.

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Figures and Tables for the

Large Mammals Section

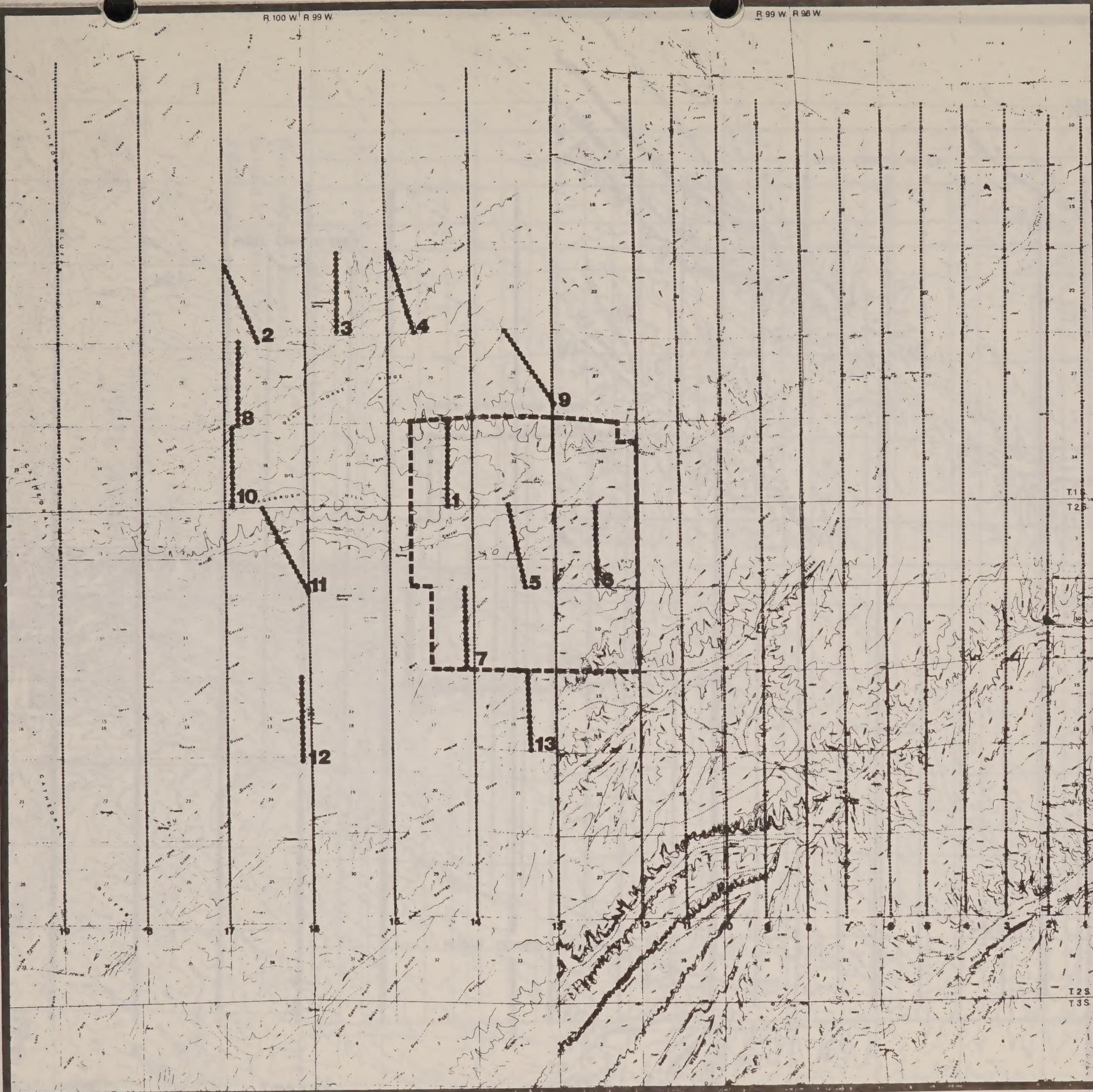

Figure 3-7-36

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

LOCATION OF AERIAL TRANSECTS

LOCATION OF PELLET PLOT TRANSECTS

0 1/2 1 2 miles

NORTH

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Fort Collins, Colorado

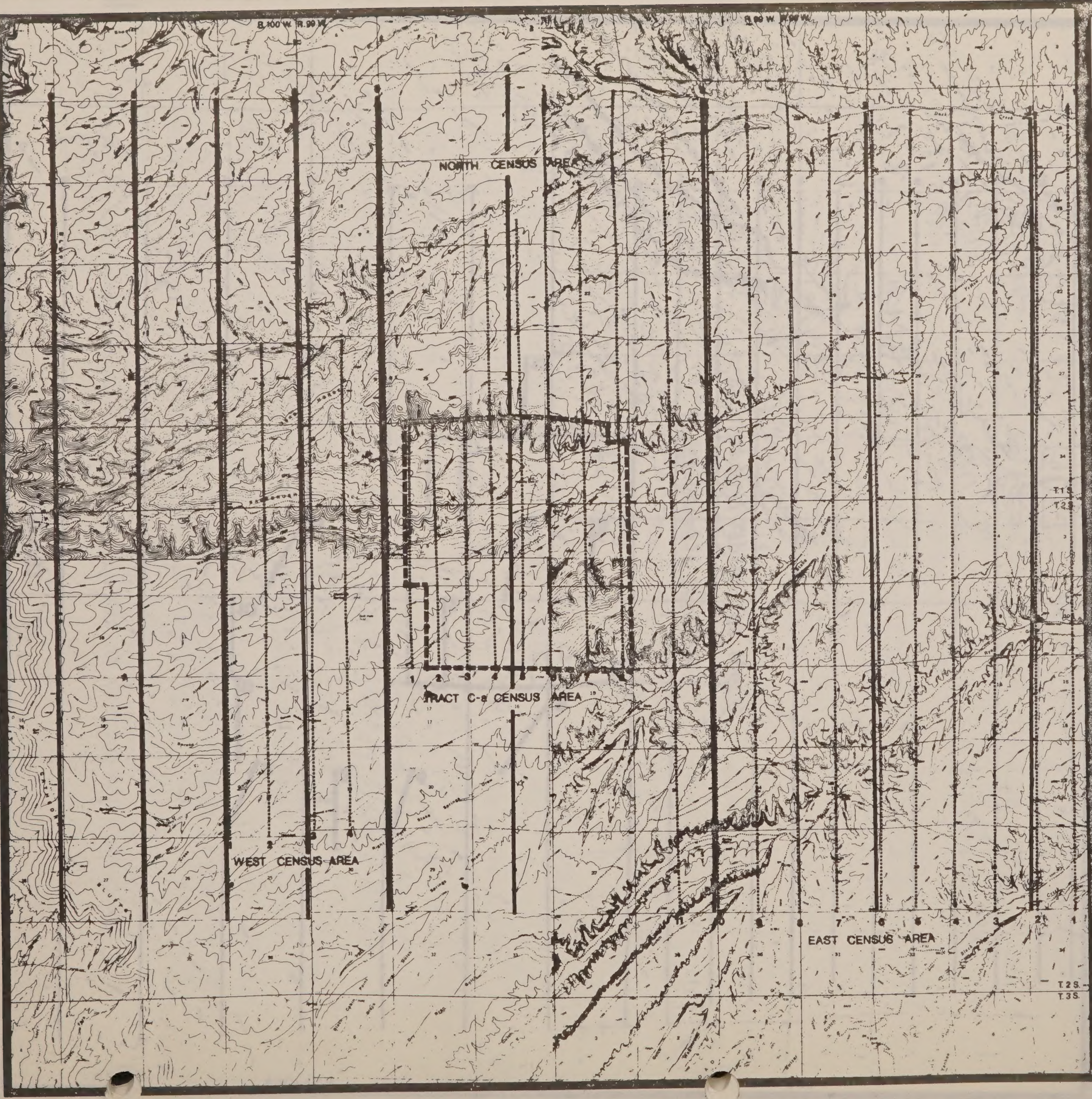


Figure 3-7-37

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS
AERIAL CENSUS

LOCATION of TRANSECTS

.... mule deer winter count

——— elk, feral horse & domestic livestock count

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

File No.____________________

LARGE MAMMAL AERIAL CENSUS REPORT AND DATA SUMMARY FORM

Proj/Study________ Date Flown________ Species__________ Survey Area__________

Observers: R__________ L__________ Pilot/Aircraft______________

Start________ Finish________ Ave. Indicated Air Speed______ Est. Altitude______

Counting Conditions: Ground Cover____________ Light________ Air________

Weather: Temp._____ Wind______ Cloud Cover______ Analyst________ QA Check________

Observations				Location	Notes and Comments
M	F	JUV	U		

Total Animals Counted:

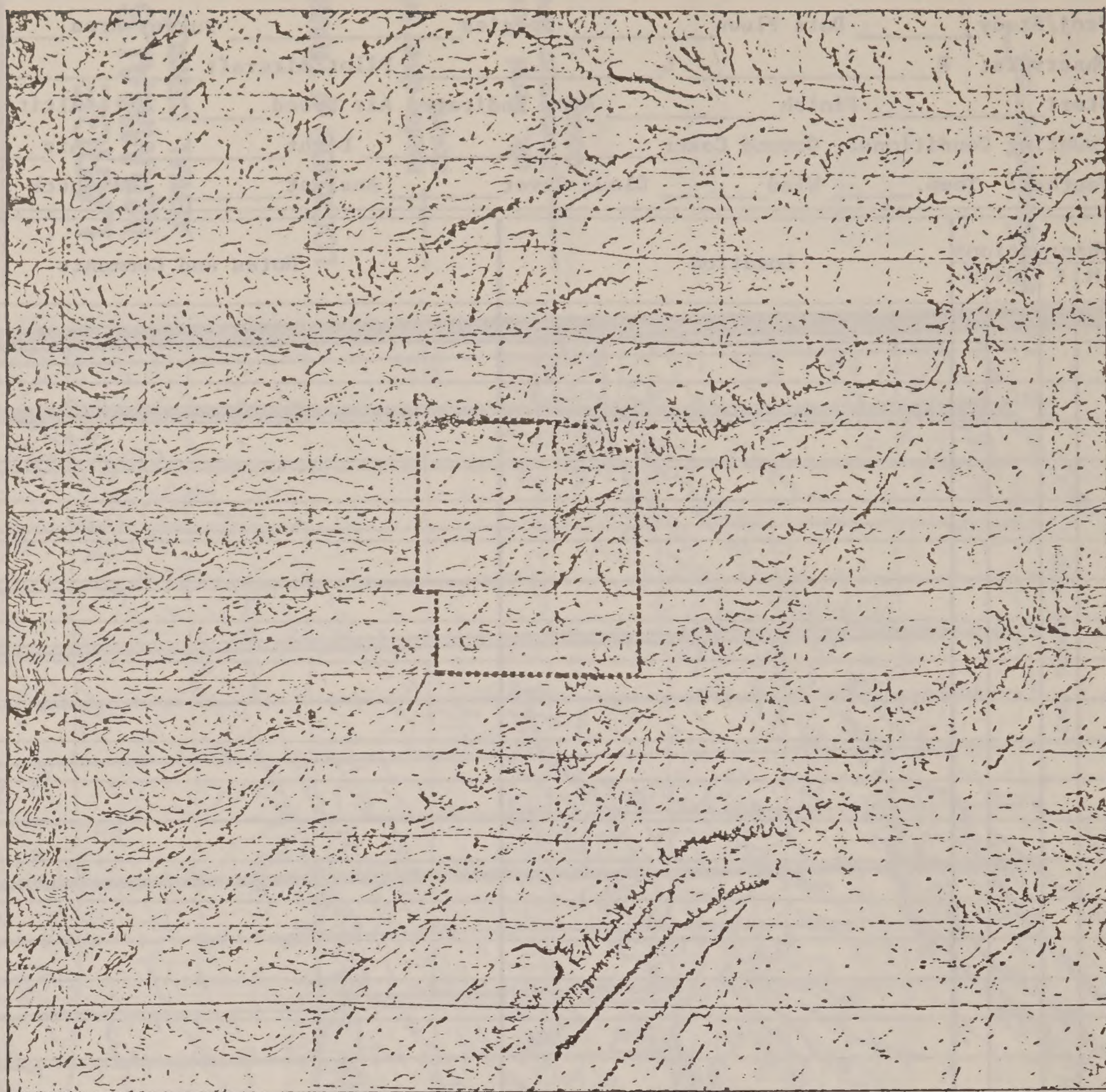
Animal Distribution:

130/060175

Figure 3-7-38

LARGE MAMMAL AERIAL CENSUS REPORT AND DATA SUMMARY FORM FOR RBOSP

FIELD OBSERVATIONS



Species________________ Date__________ Time__________

Means of Identification______________________________

Number Observed__________ ♂__________ ♀__________

Adult__________ Juv.__________

Habitat______________________________

Other Information*______________________________

____

Observer________________

* Include any distinguishing field marks for horses.

048/060175

Figure 3-7-39

FIELD OBSERVATION SHEET FOR RBOSP

Figure 3-7-40

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

mule deer migration count aerial transects

mule deer track count transect

location of pellet plot transects

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

LARGE MAMMAL TRACK COUNT FIELD DATA SHEET

Project/Study__________ Date__________________ Observer__________________ Sheet ____ of ____

Route Description____ QA Check__________

No. of Tracks		Location	Notes
In	Out		
		Totals	

129/081575

Figure 3-7-41

LARGE MAMMAL TRACK COUNT FIELD DATA SHEET FOR RBOSP

SINGLE TRANSECT PELLET GROUP COUNT FIELD DATA SHEET

Project:__________ Transect:______________________________ Plot Size:______________

Location:____

Date Pellet Groups Initially Removed:____________________ Survey No:______________

Plot No.	Inspector: Date: Pellet Groups Observed	Landscape and Vegetation Information
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
Total		

126/060175

ecology consultants, inc.

Figure 3-7-42

SINGLE TRANSECT PELLET GROUP COUNT FIELD DATA SHEET FOR RBOSP

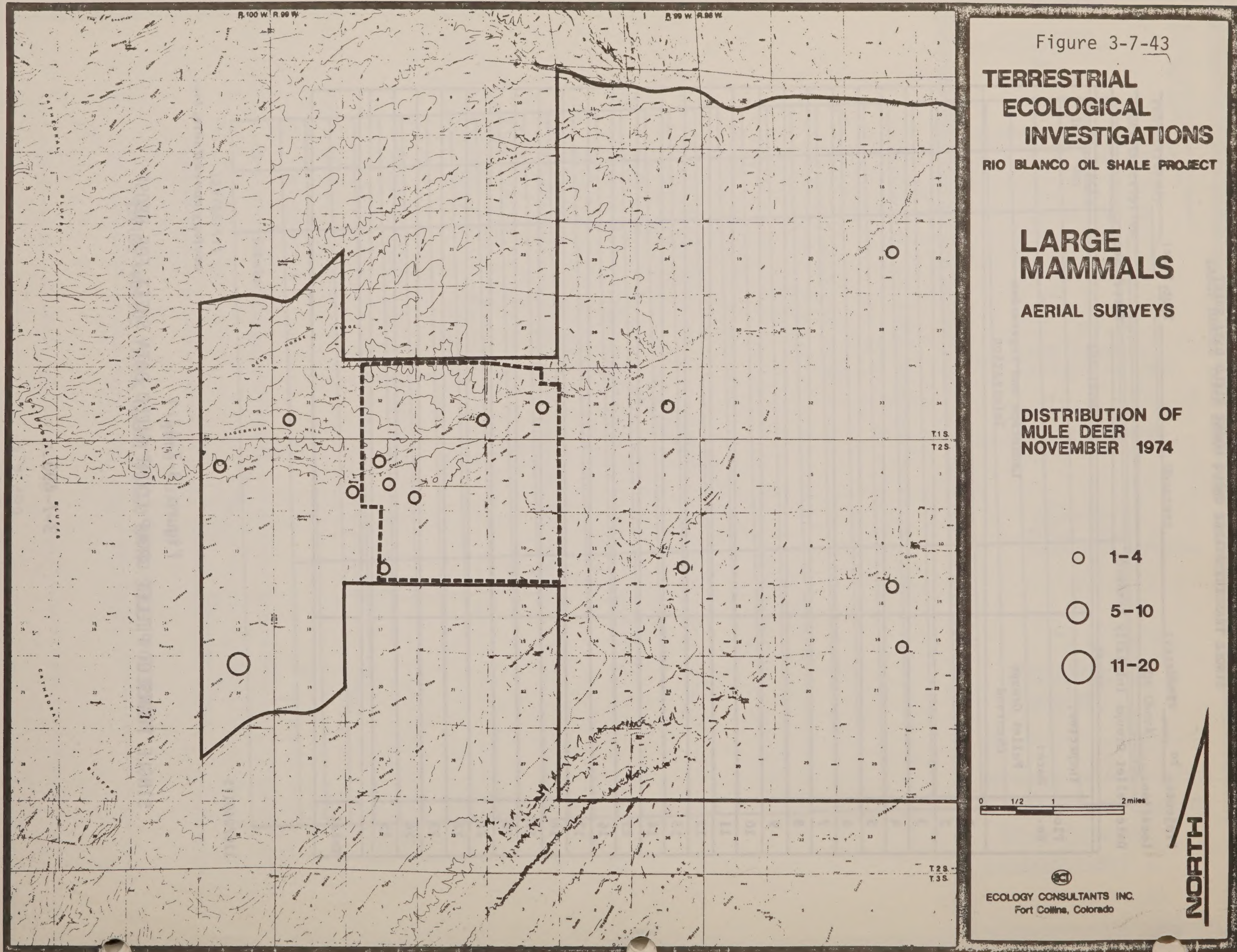


Figure 3-7-43
TERRESTRIAL
ECOLOGICAL
INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
LARGE
MAMMALS
AERIAL SURVEYS
DISTRIBUTION OF
MULE DEER
NOVEMBER 1974
1-4
5-10
11-20
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R.100 W. R.99 W.
R.99 W. R.98 W.
T.1 S.
T.2 S.
T.2 S.
T.3 S.

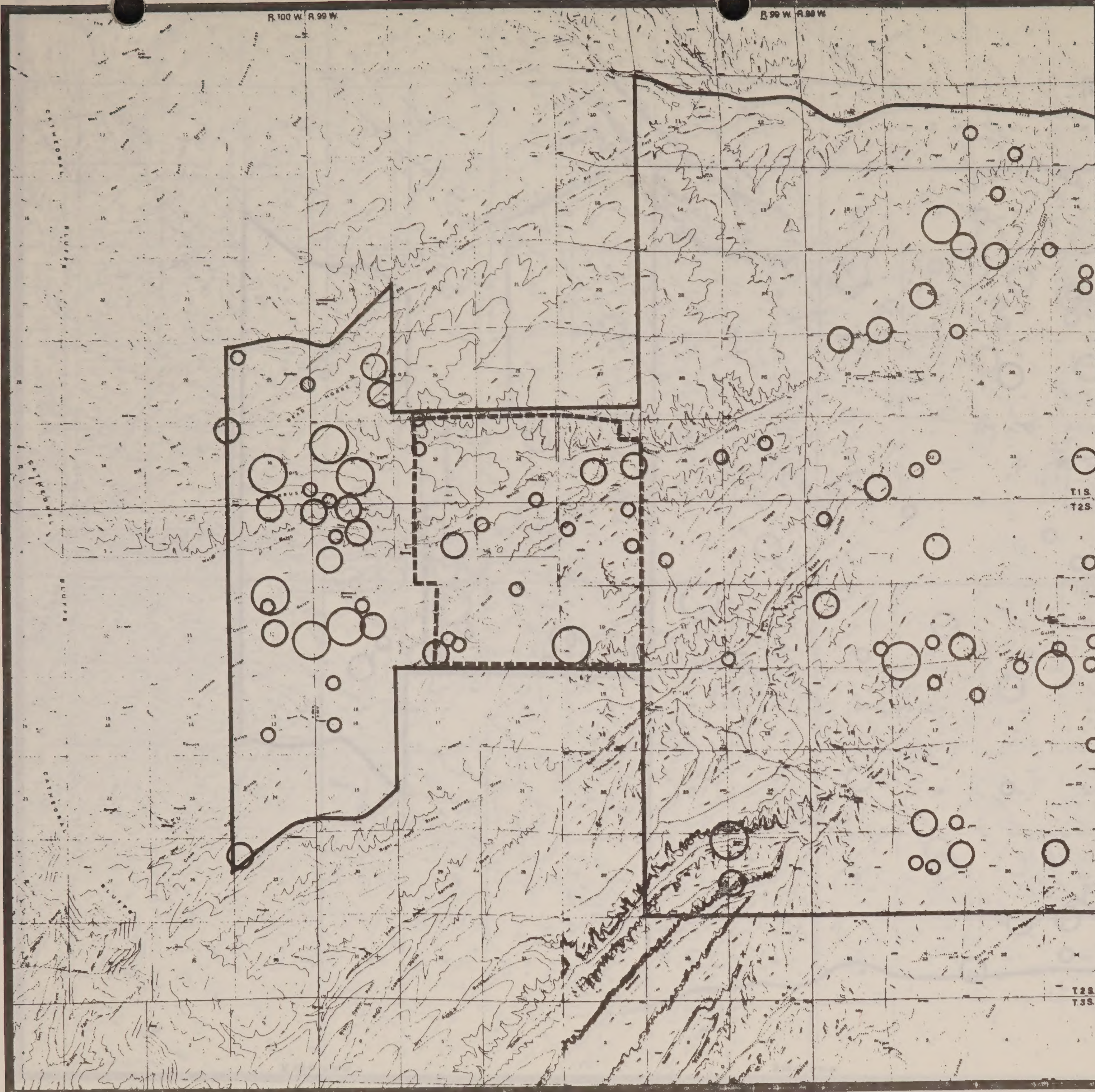


Figure 3-7-44

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

AERIAL SURVEYS

DISTRIBUTION OF MULE DEER DECEMBER 1974

1-4

5-10

11-20

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

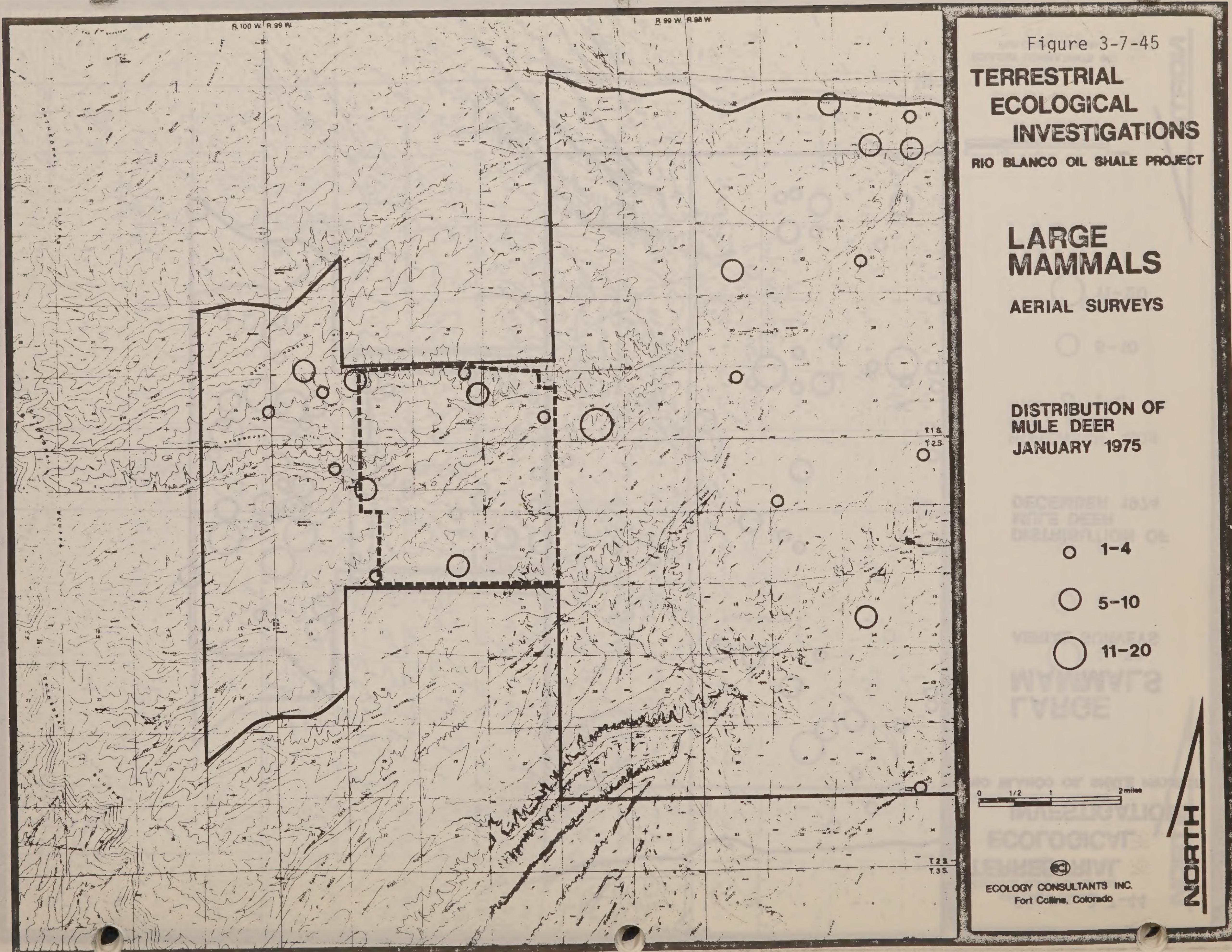


Figure 3-7-45
TERRESTRIAL ECOLOGICAL INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
LARGE MAMMALS
AERIAL SURVEYS
DISTRIBUTION OF MULE DEER JANUARY 1975
1-4
5-10
11-20
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R.100 W. R.99 W.
R.99 W. R.98 W.
T.1S.
T.2S.
T.2S.
T.3S.

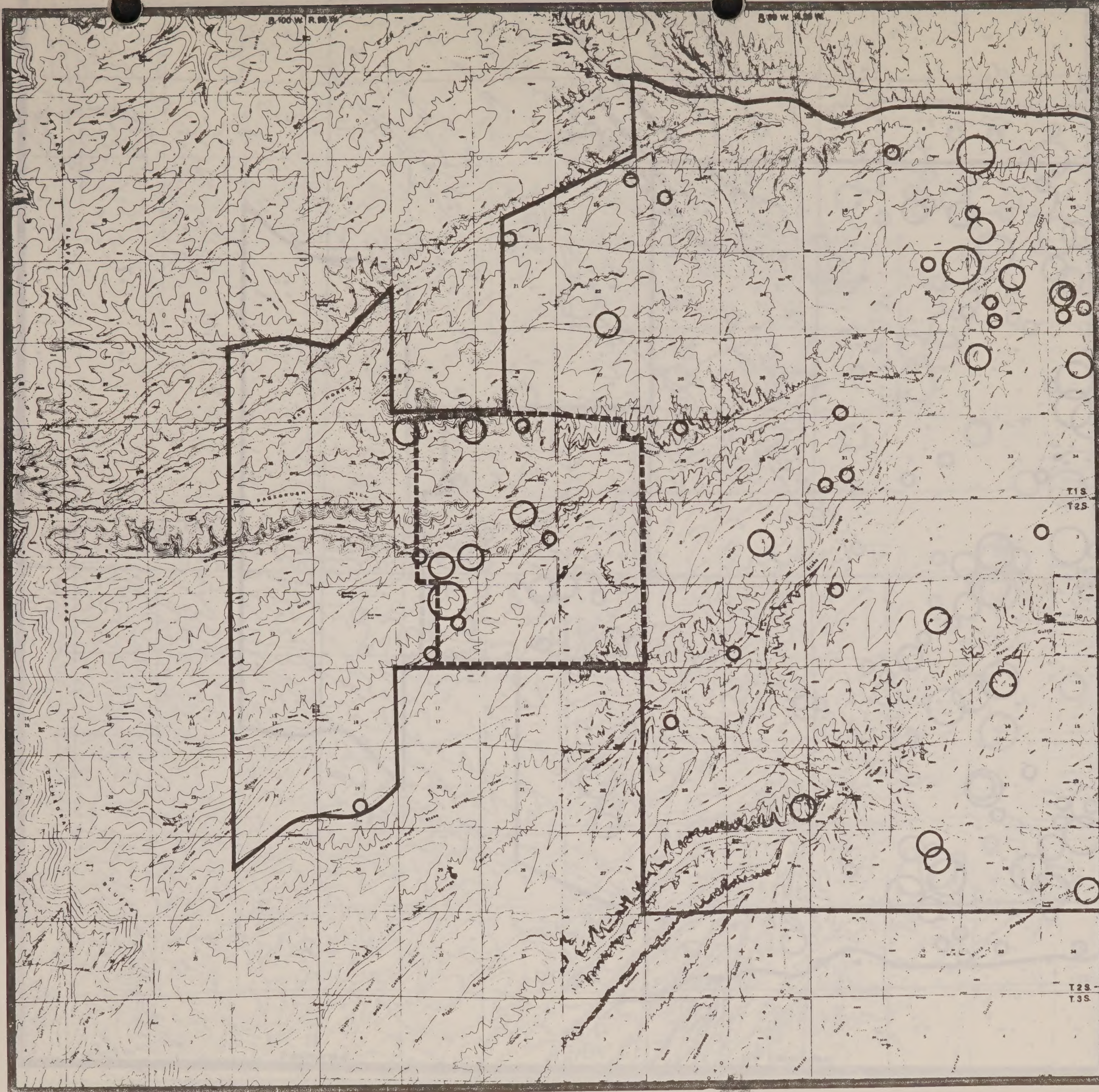


Figure 3-7-46

TERRESTRIAL
ECOLOGICAL
INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

AERIAL SURVEYS

DISTRIBUTION OF
MULE DEER
FEBRUARY 1975

○ 1-4

○ 5-10

○ 11-20

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

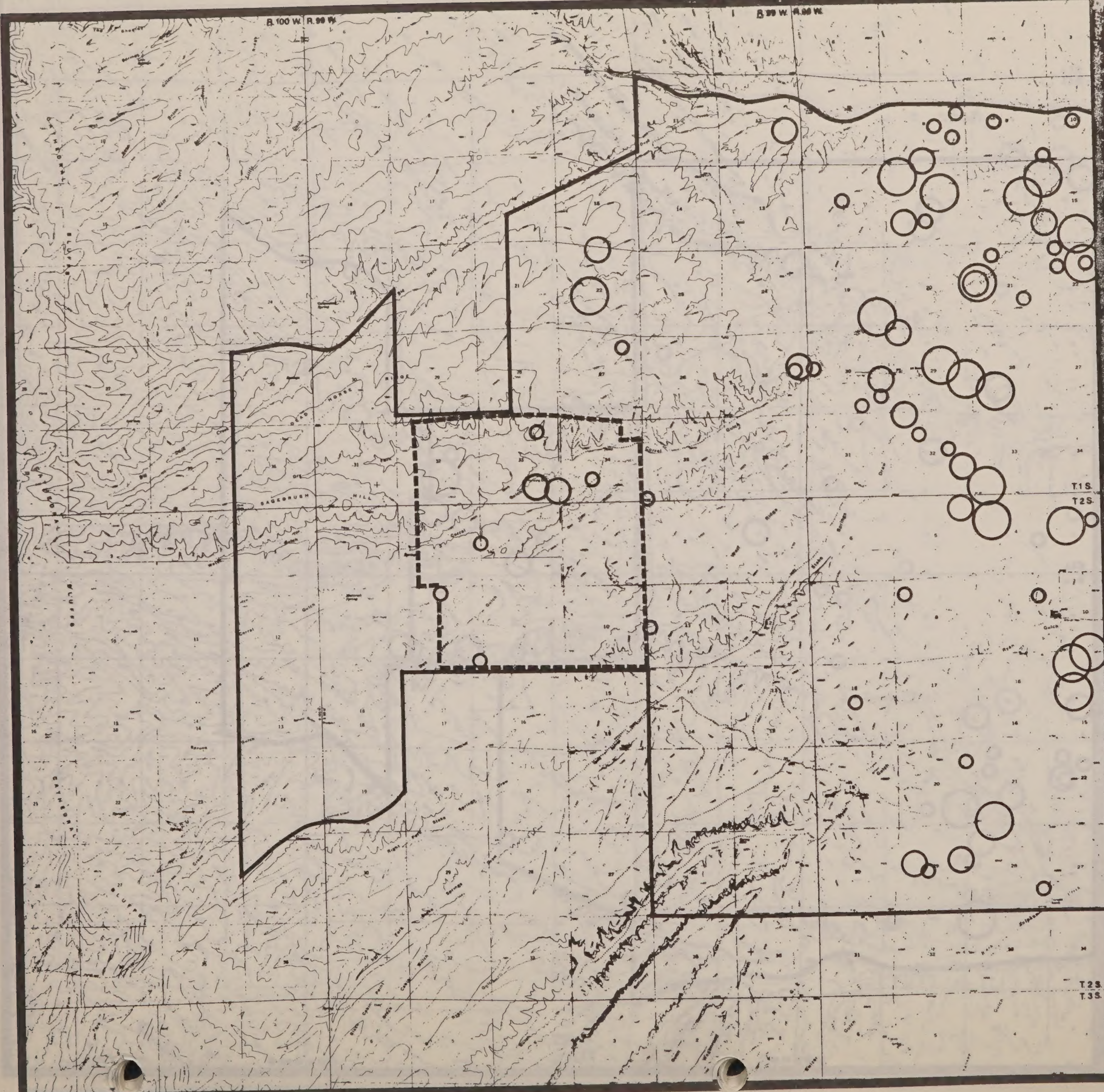


Figure 3-7-47

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

AERIAL SURVEYS

DISTRIBUTION OF MULE DEER MARCH 1975

1-4

5-10

11-20

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

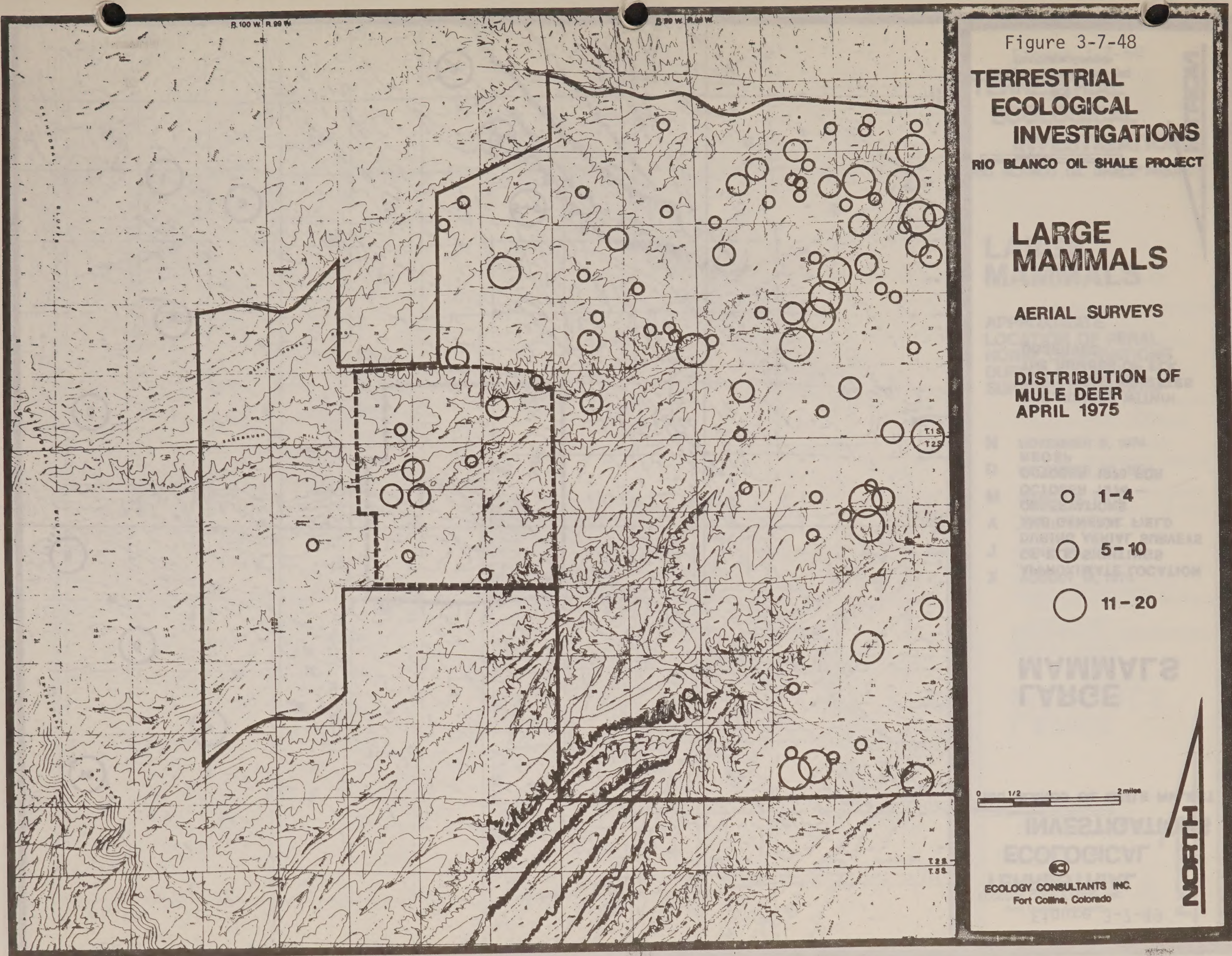


Figure 3-7-48
TERRESTRIAL ECOLOGICAL INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
LARGE MAMMALS
AERIAL SURVEYS
DISTRIBUTION OF MULE DEER APRIL 1975
1-4
5-10
11-20
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R.100 W. R.99 W.
R.99 W. R.98 W.
T.1 S.
T.2 S.
T.2 S.
T.3 S.

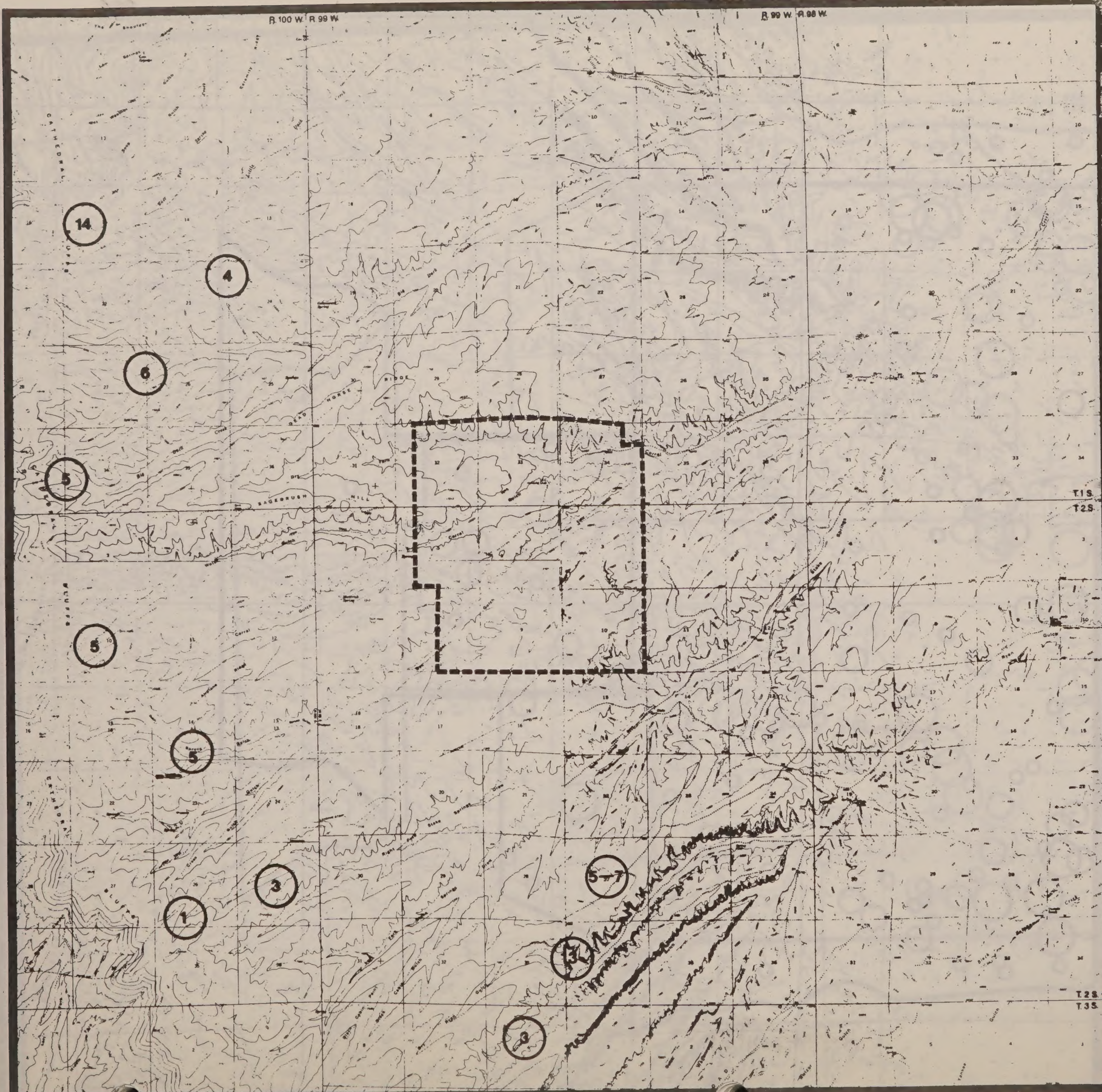


Figure 3-7-49

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

APPROXIMATE LOCATION OF ELK SIGHTINGS DURING AERIAL SURVEYS AND GENERAL FIELD OBSERVATIONS OCTOBER 1974 – OCTOBER 1975 FOR RBOSP

THE NUMBER WITHIN THE CIRCLE INDICATES THE NUMBER OF ELK OBSERVED

0 1/2 1 2 miles

NORTH

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Fort Collins, Colorado

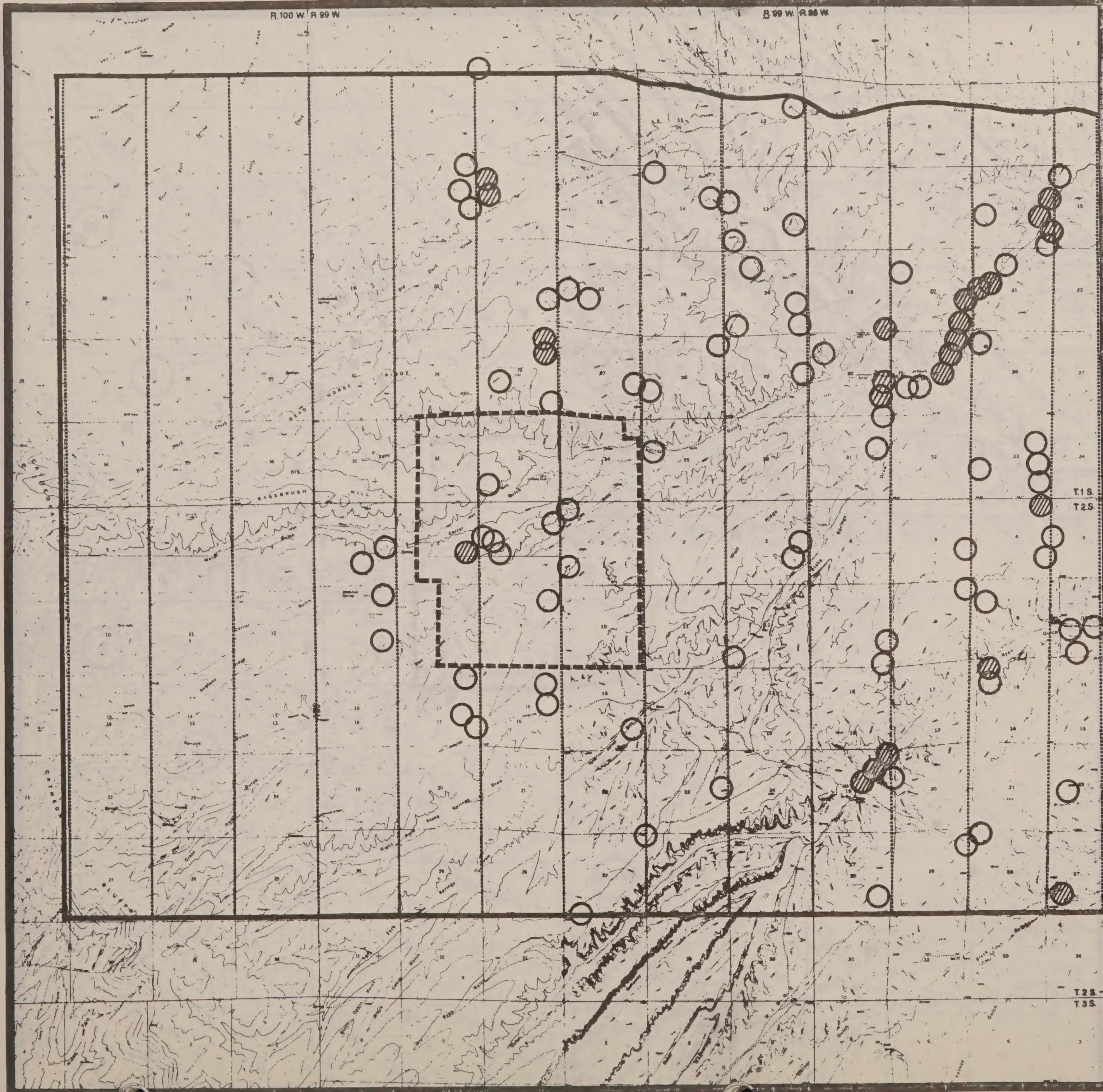

Figure 3-7-51

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

MULE DEER MIGRATION MOVEMENT

APPROXIMATE LOCATION OF MULE DEER OBSERVED DURING SIX AERIAL SURVEYS FROM APRIL 13 - 26, 1974 FOR THE RBOSP

MULE DEER OBSERVED DURING ONE SURVEY

MULE DEER OBSERVED DURING MORE THAN ONE SURVEY

AERIAL SURVEY TRANSECTS

0 1/2 1 2 miles

NORTH

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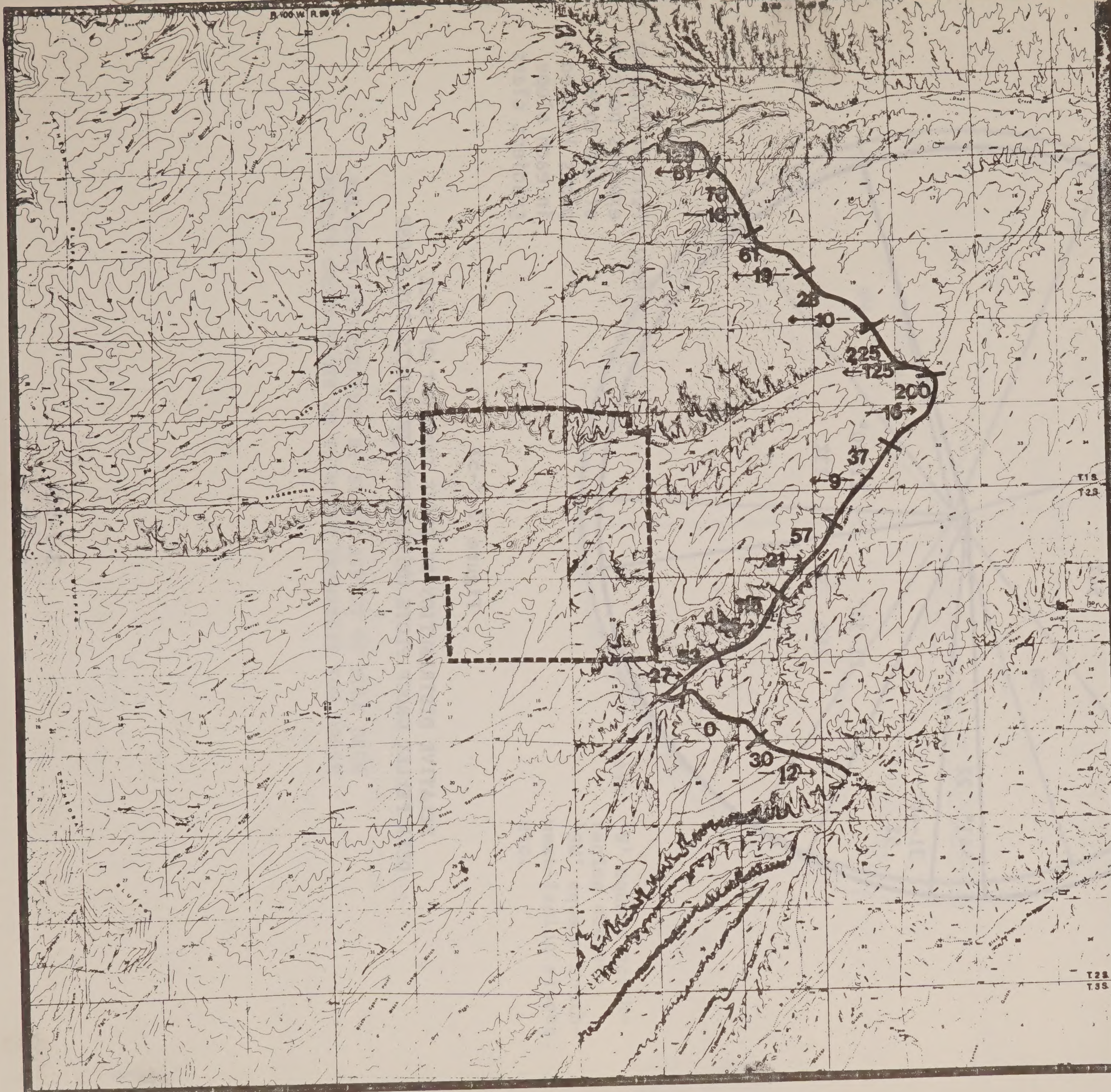


Figure 3-7-52

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

MULE DEER MIGRATION MOVEMENT

NUMBER OF TRACKS COUNTED ABOVE ROAD EAST OF TRACT C-A DURING APRIL 1974

UPPER NUMBER INDICATES TRACKS CROSSING IN TWO DIRECTIONS

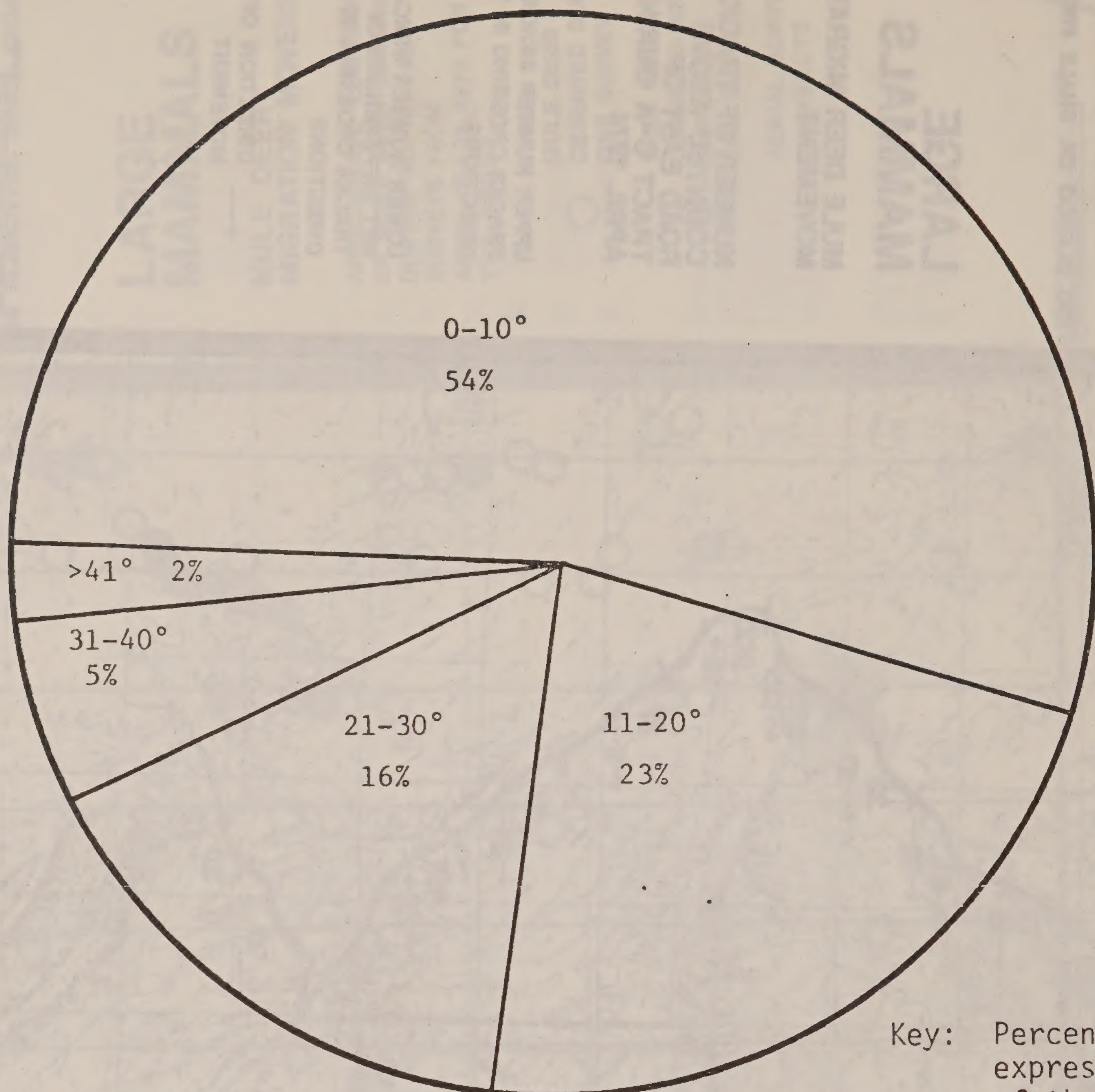
LOWER NUMBER INDICATES NET DIFFERENCES OF TRACKS CROSSING IN TWO DIRECTIONS

← DIRECTION OF MOVEMENT

0 1/2 1 2 miles

NORTH

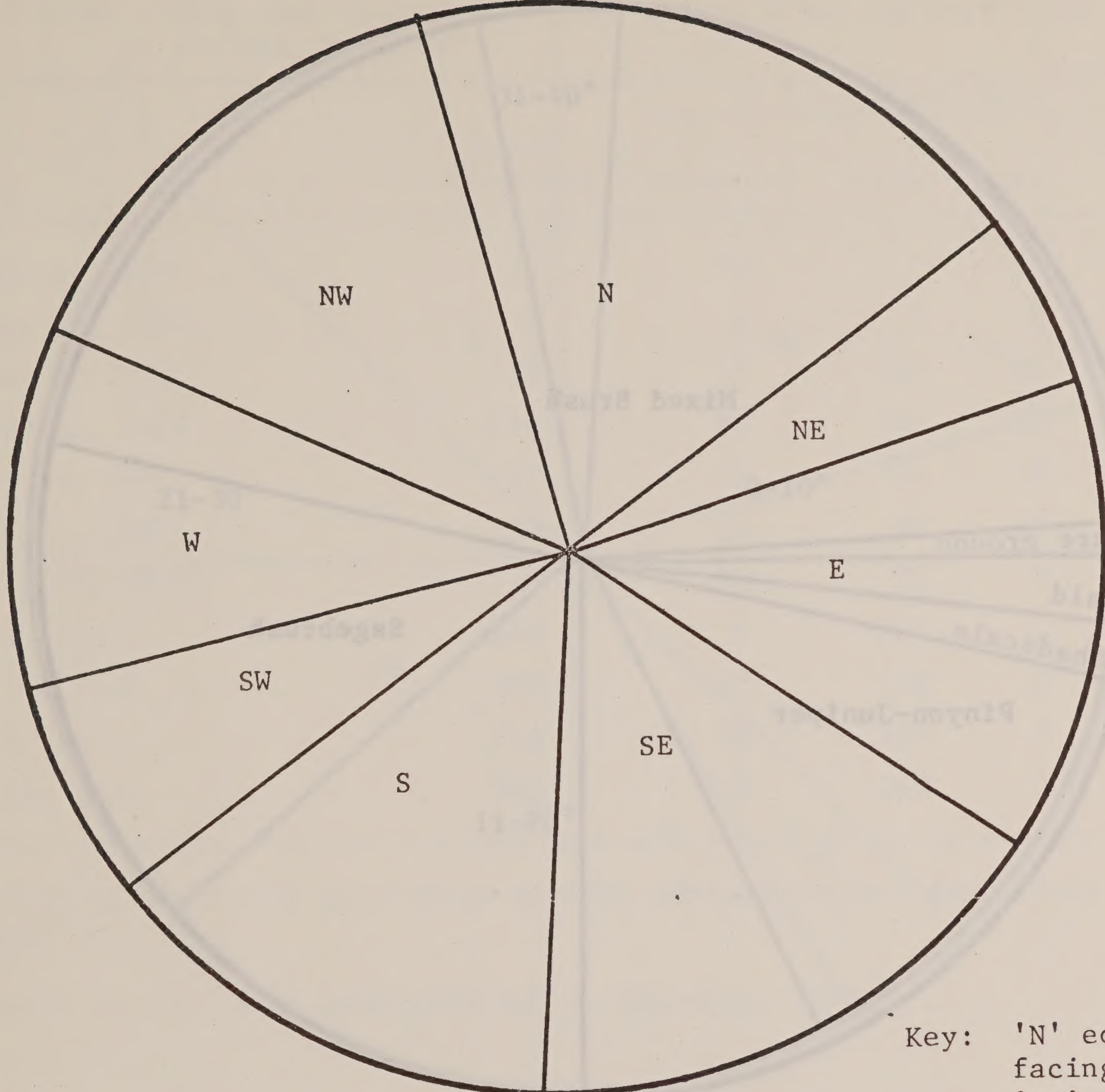
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado



Key: Percent figures express portion of the total plots located in each slope gradient class

Figure 3-7-53

RELATIVE DISTRIBUTION BY SLOPE GRADIENT OF MULE DEER PELLET GROUP PLOTS ON THIRTEEN TRANSECTS FOR RBOSP



Key: 'N' equals north-facing slopes; 'SW' equals south-west-facing slopes, etc.

Figure 3-7-54

RELATIVE DISTRIBUTION BY SLOPE ASPECT OF MULE DEER PELLET GROUP PLOTS ON THIRTEEN TRANSECTS FOR RBOSP

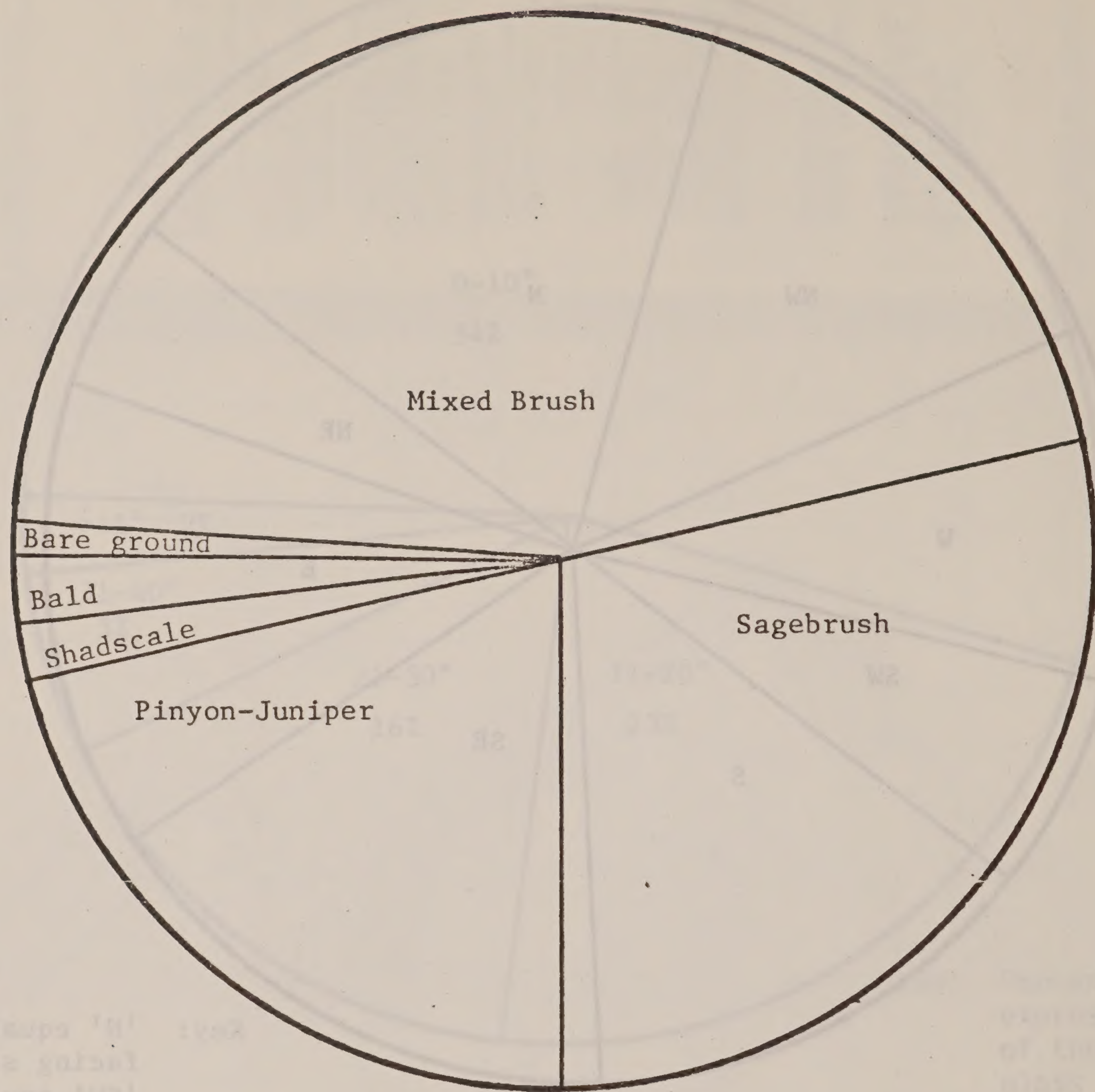


Figure 3-7-55

RELATIVE DISTRIBUTION BY VEGETATION TYPE OF MULE DEER PELLET GROUP PLOTS ON THIRTEEN TRANSECTS FOR RBOSP

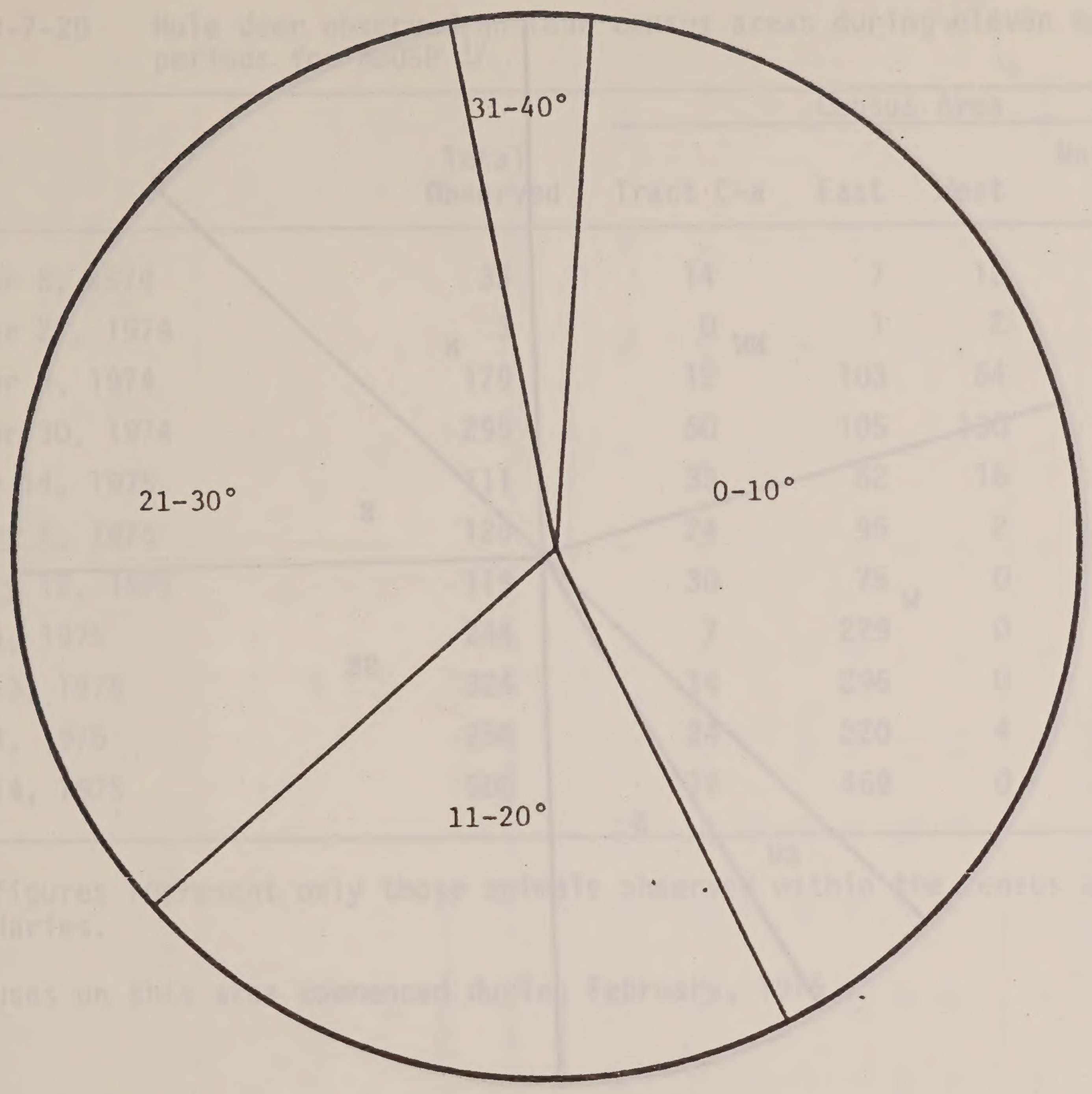


Figure 3-7-56.

RELATIVE DISTRIBUTION BY SLOPE GRADIENT OF MULE DEER PELLET GROUPS ACCUMULATED OVER SUMMER 1975 FOR RBOSP

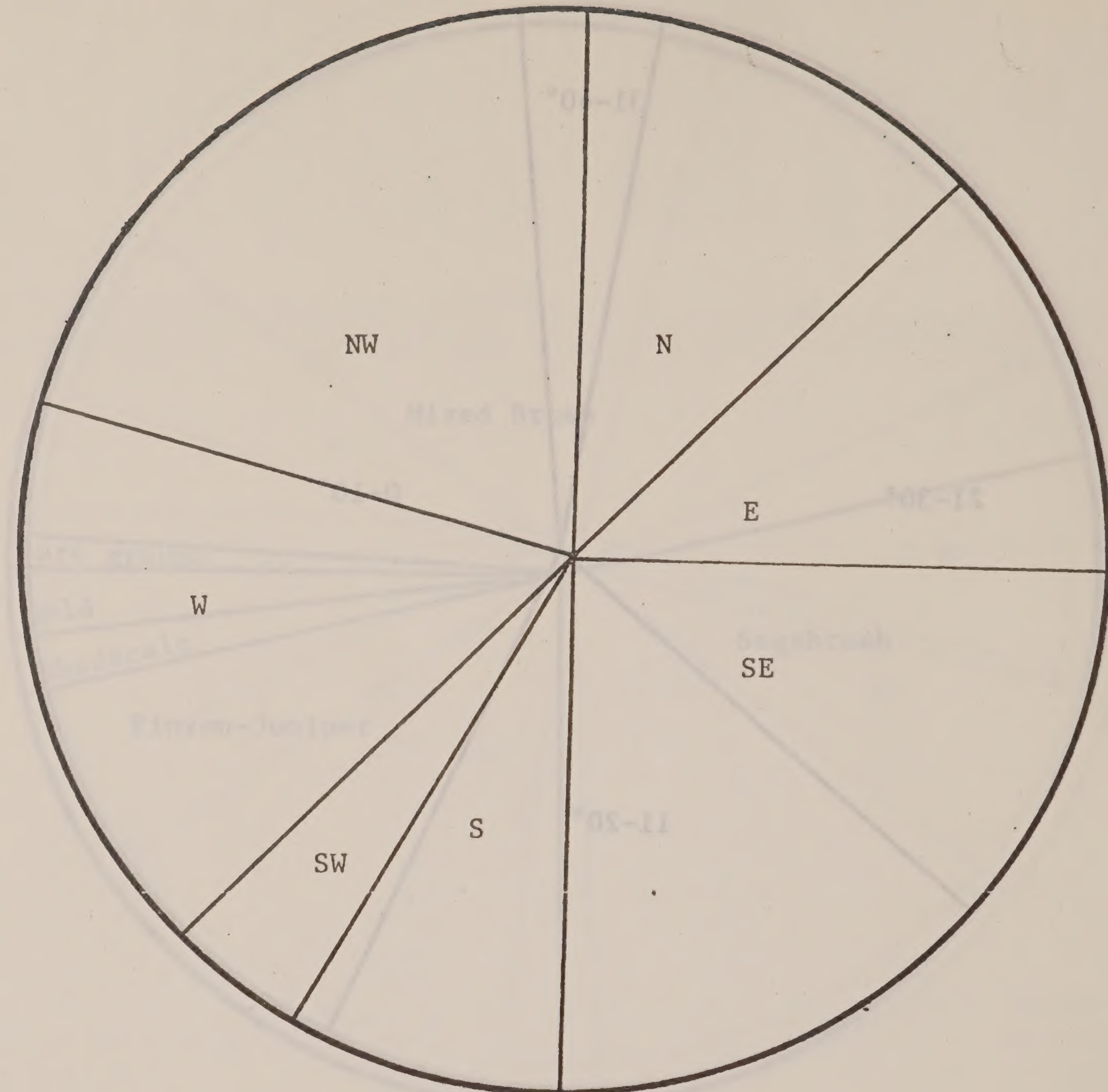


Figure 3-7-57
RELATIVE DISTRIBUTION BY SLOPE ASPECT OF
PELLET GROUPS ACCUMULATED OVER SUMMER 1975 FOR RBOSP

Table 3-7-20 Mule deer observed on four census areas during eleven survey periods for RBOSP [1]

Date of Census	Total Observed	Census Area: Tract C-a	East	West	North of Tract [2]
November 8, 1974	33	14	7	12	--
November 21, 1974	3	0	1	2	--
December 9, 1974	179	12	103	64	--
December 30, 1974	295	60	105	130	--
January 14, 1975	111	33	62	16	--
February 1, 1975	125	24	95	2	4
February 12, 1975	119	30	75	0	14
March 4, 1975	244	7	229	0	8
March 13, 1975	324	14	296	0	14
April 3, 1975	258	24	220	4	10
April 14, 1975	500	12	469	0	19

1/ The figures represent only those animals observed within the census area boundaries.

2/ Censuses on this area commenced during February, 1975.

Table 3-7-204. Number of mule deer observed by transect during migration study aerial censuses April 13-26, 1975 for RBOSP*

Date	Transect Number													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
April 13, 1975	125	87	40	4	50	7	8	40	0	0	0	0	0	361
April 15, 1975	45	50	19	41	10	0	22	17	17	0	0	0	0	221
April 19, 1975	35	135	86	1	49	0	8	10	0	0	0	0	0	324
April 21, 1975	57	195	177	7	4	14	33	60	0	0	0	0	0	547
April 23, 1975	13	50	8	0	3	8	34	9	30	0	0	0	0	155
April 26, 1975	35	65	39	17	11	26	39	44	0	0	NC	NC	NC**	276
TOTALS BY TRANSECT	310	582	369	70	127	55	144	180	47	0	0	0	0	1884

*Refer to Figures 3-7-40 and 3-7-51 for transect locations and mule deer distribution, respectively.

**Not censused due to unfavorable weather conditions.

Table 3-7-205. Number of mule deer tracks crossing the dirt road surveyed east of Tract C-a during April 13-23, 1975 for RBOSP*

Date Recorded	Total Tracks Recorded	General Direction of Movement: West Toward Tract C-a	General Direction of Movement: East Away From C-a	Net Number of Tracks Moving Generally Toward Tract C-a
April 15, 1975	56	48	8	40
April 17, 1975	106	58	48	10
April 19, 1975	280	175	105	70
April 21, 1975	287	123	164	-41
April 23, 1975	282	160	122	38
TOTAL	1011	564	447	117

*One track equals footprints of one individual.

Table 3-7-206. Mule deer pellet-groups accumulated over winter, 1974-75 on four transects located on Tract C-a for RBOSP

Transect Number	Pellet Groups Recorded	Pellet Groups Per Acre	Period of Accumulation (days)	Pellet Groups Index 1/
1	4	69.7	209	0.33*
5	14	243.9	211	1.16
6	11	191.7	208	0.92
7	7	122.0	209	0.58

*Pellet-group index equals the pellet groups per acre divided by the period of accumulation.

$\bar{x} = 9.0$

$n = 4$

$SD = 4.40$

$S\bar{x} = 2.2$

90% confidence interval

$9 \mp (2.353 \times 2.2) = 9 \mp 5.2$

Table 3-7-207. Mule deer pellet-groups accumulated during summer 1975 on 13 transects on and near Tract C-a for RBOSP

Transect Number	Pellet Groups Recorded	Pellet Groups Per Acre	Period of Accumulation (days)	Pellet Group Index*
1	0	0.0	125	0.0
2	4	69.7	123	0.57
3	2	34.8	125	0.28
4	1	17.4	125	0.4
5	0	0.0	125	0.0
6	0	0.0	125	0.0
7	0	0.0	125	0.0
8	3	52.3	123	0.43
9	1	17.4	127	0.14
10	6	104.5	125	0.81
11	5	87.1	125	0.70
12	2	34.8	128	0.27
13	0	0.0	129	0.0

*Pellet group index equals the pellet groups per acre divided by the accumulation period.

$\bar{x} = 1.85$

$n = 13$

$SD = 2.08$

$S\bar{x} = 0.58$

90% Confidence interval

$1.85 \mp (1.782 \times 0.58) = 1.85 \mp 1.03$

Table 3-7-208. Calculation of sample size necessary to produce a sample with a 0.20 selected risk of error at the 90% confidence level for mule deer pellet-group counts for RBOSP (Formula from Grieb, 1958 - as cited in Neff, 1968)

$$N = \frac{(t_{0.10})^2 s^2}{(0.20 \times \bar{x})^2}$$

Where:

N = number of plots or transects required

s^2 = variance of the preliminary sample data

$\bar{x}$ = mean of the preliminary sample data

0.20 = selected risk of error (e.g., if the estimate is expected to fall within 20% of the mean 90 times out of 100, use 0.20 times the mean)

$t_{0.10}$ = tabular value for the selected level of probability.

Based on summer 1975 accumulation period.

$$N = \frac{(1.78)^2\ 4.28}{(0.20 \times 1.85)^2}$$

= 99 transects necessary
-13 transects presently established

86 additional transects would be necessary to produce the desired accuracy.

Table 3-7-209. Mule deer pellet group accumulation over summer 1975 on six vegetation types sampled for RBOSP

Vegetation Type	Pinyon-Juniper	Mixed Brush	Sagebrush	Shadscale	Bald	Bare
Number of Pellet Groups	0	22	2	0	0	0
Percent of Total	0	92	8	0	0	0

Table 3-7-210. Mule deer pellet groups accumulated over summer 1975 on five slope gradients sampled for RBOSP

Slope Gradient	0-10^{o}	11-20^{o}	21-30^{o}	31-40^{o}	41^{o}
Number of Pellet Groups	10	5	8	1	0
Percent of Total	42	21	33	4	0

Table 3-7-210. Mule deer pellet groups accumulated over summer 1975 on five slope gradients sampled for RBOSP.

Slope Gradient	0-10°	11-20°	21-30°	31-40°	>41°
Number of Pellet Groups	10	5	8	1	0
Percent of Total	42	21	33	4	0

Table 3-7-211. Mule deer pellet group accumulation over summer 1975 on eight slope aspects sampled for RBOSP

Slope Aspect	N	NE	E	SE	S	SW	W	NW
Number of Pellet Groups	3	0	3	6	2	1	4	5
Percent of Total	13	0	13	25	8	4	17	20

C. Mammalian Predators

1. Objectives - The purpose of the mammalian predator investigations is to document the distribution and relative abundance of large predators (coyotes, bobcats, black bears and mountain lions) and small predators (ringtails, martens, weasels, etc.) within and adjacent to Tract C-a. A further objective is to determine from any records compiled by state and federal agencies the impact these larger predators, particularly coyotes, may have on big game animals and domestic livestock in the region.

2. Methods

a. Data Collection - Two census methods, the scent-station visitation technique and the siren-elicited howling response procedure, are being used to gather information on large predator populations. These methods were selected after a thorough review of the literature and promise to yield reliable indices of large predator abundance and distribution.

1) Scent-Station Visitation Technique - The scent-station visitation technique was developed in New York State by Cook (1949), who suggested that records of fox sign at scent posts provided a practical index to the relative abundance of foxes between areas, and from year to year. In Wisconsin, Richards and Hine (1953) used a variation of this technique in a survey conducted to inventory foxes, as did Wood (1959) in 25 counties in Florida, South Carolina and Georgia.

The method has been standardized by the Denver Wildlife Research Center (Linhart and Knowlton, 1973). In cooperation with the Division of Wildlife Services, the Center has used scent stations to survey the relative abundance of predators in 17 western states. Approximately 350 scent-station lines of 50 stations each were distributed across more than 1.8 million sq mi and checked during fall 1972 to 1975, as part of a federal monitoring program. The results of the ongoing program are currently housed in ECI's library. Additional results will be available from the Fish and Wildlife Service since analysis of federal data will, in future years, be the responsibility of this

agency. A statistical evaluation of the survey method is being developed under federal contract with Oregon State University, and a contract completion report is expected in 1975. An adaptation of this method is used on and near Tract C-a so that data collected by ECI personnel might generally be comparable to data obtained by federal agencies.

The technique, as applied on Tract C-a, involves the initial establishment of one "survey line" for November 1974 and February 1975, and the addition of a second survey line for June 1975 and all subsequent sampling periods. Each survey line consists of 50 scent-stations spaced approximately 0.5 km (0.3 mi) apart along a 24 km (14.7 mi) route (Figure 3-7-58). At each station, a small perforated plastic capsule containing about 1 g of granulated fermented egg attractant is positioned in the center of a circle of sifted earth 0.9 m (3.0 ft) in diameter. During sampling periods when snow is present, stations are placed in an unmarked patch of snow; only those tracks within the 0.9 m circle are recorded. The capsule is supported above the ground or snow by a thin wire rod. Stations are placed adjacent to the road edge and alternated from left to right sides of the road to reduce the influence of wind direction. Survey routes are checked daily for 5 consecutive days every fourth month, beginning in November 1974 (originally scheduled for October) and continuing through June 1976. Animal visits based on tracks are recorded for each station on a standard field data form (Figure 3-7-59).

Stations that are visited or disturbed are resifted or, in the case of snow, relocated in an unmarked area nearby. The fermented-egg attractant remains active throughout the 5-day sampling period and is only replaced if rendered ineffective by wind, rain, sleet, or animals (Linhart and Knowlton, 1973). An olfactory check is made when conditions suggest the possibility of attractant ineffectiveness.

2) Coyote Siren Survey - The siren-elicited howling response coyote census technique is being employed concurrently with the scent-station visitation technique. The former method has been tested by the Denver Wildlife Research Center (Carley, 1973) and has been used by the Oregon State Game and Fish Agency (Wolfe, 1974). The following procedures, patterned after Alcorn

(1971a, 1971b) of the Bureau of Sport Fisheries and Wildlife, are being used for Tract C-a. A 48 km (30 mi) transect consisting of permanently marked siren stations spaced approximately 4.8 km (3 mi) apart was established along existing roads as shown in Figure 3-7-58 . To help maintain a 10-station sample during nights when wind or noise interferes with data collection, an eleventh station has been added to the end of the transect. A maximum of 10 of the 11 stations are surveyed and data recorded on the data sheet for any one night. At each station, an electronic siren is sounded for two complete pitch cycles (~20 seconds), followed by a 1-minute listening period. A second two-cycle sounding of the siren is followed by a 2-minute listening period.

Data recorded on a standard form (Figure 3-7-60) include time of soundings, response (defined as the number of groups or identifiable individuals heard) to the first sounding, response to the second sounding and total response (the addition of the recorded howling response during the two listening periods). Notes on conditions which might affect data such as wind, precipitation, proximity to humans, or interference by noise are also recorded. Alcorn (1971a, 1971b) and Wolfe (1974) recommended that the survey be discontinued or the affected station eliminated if winds are encountered in excess of 10 mph or if precipitation occurs. Stations where there is much interference by noise are omitted from the computation of relative abundance indices. Siren sampling is accomplished after dark on two nights with suitable weather conditions during the scent-station sampling period.

3) <u>Other Large Predator Investigations</u> - Two other kinds of field evidence are being compiled on the distribution and relative abundance of large mammalian predators. During all aerial surveys of large mammals and raptors, the observing biologists record and map the locations of all large predators seen. Additional field data will be accumulated on field observation sheets (Figure 3-7-39) during winter track counts and other field programs.

In addition to a literature search for specific information of past records of abundance and distribution of large mammalian predators in this area, State

of Colorado Division of Wildlife personnel are being interviewed for records of damage claims to livestock, and for hunting kill and trapping records of predaceous mammals in the region.

4) Small Predators - Havahart live traps baited with material deemed appropriate by a review of the literature are being routinely set during small mammal, mammalian predator, and winter track count sampling conducted in every major habitat type in the study area. All traps are checked daily; any animal captured is identified to species and released. Location of captures, sightings by field personnel, scats, dens, and other definitive signs are carefully plotted on field maps (Figure 3-7-39). Compilation of all maps will supplement trapping data in determining the distribution of small mammalian predators within and adjacent to Tract C-a.

b. Data Analysis

1) Scent-Station Visitation Technique - Mammalian predator scent-station visitation data are summarized by day and summed for the sampling period to yield the total number of operable station-nights and the total number of visits of each species (Figure 3-7-61). Relative abundance indices are calculated by dividing the total number of visits of each species by the total number of operable station-nights and multiplying the quotient by 1,000 (Linhart and Knowlton, 1973).

2) Coyote Siren Survey - Data gathered in siren-elicited howling response surveys are summarized to yield the total number of stations where the siren was sounded during the sampling period, the total number of stations where a response (coyote howl) was heard, and the total number of coyote groups that responded (Figure 3-7-61). The number of groups was determined by noting the sets of howls from different directions. A group can consist of one to several individuals. Two separate indices are calculated from these data: (1) the station-response index, defined as the total number of stations where a response was recorded divided by the total number of stations

where the siren was sounded and multiplying the quotient by 100; and (2) the group-response index, defined as the total number of groups that responded divided by the total number of stations where the siren was sounded and multiplying the quotient by 100.

3. Data Summary - The mamalian predator scent-station survey was initiated on November 11 through 15, 1974, and repeated during February 10 through 14, 1975, June 22 through 26, 1975 and October 19 through 23, 1975. The siren-elicited howling response method as a coyote survey technique was employed concurrently with the scent-station method on two nights of suitable weather conditions during the sampling period. The specific dates of the siren survey were November 11 and 13, 1974; February 10 and 12, 1975; June 22 and 25, 1975; and October 19, 1975. Only one night of the siren survey was performed during October 1975 because of unfavorable weather conditions and the onset of mule deer hunting season.

The results of the scent-station survey and the corresponding relative abundance indices for all sampling periods are summarized in Table 3-7-212, and the results of federally surveyed lines within similar habitats with similar physiographic characteristics are presented in Table 3-7-213. Siren elicited howling response results are summarized in Table 3-7-214.

a) Scent-station Visitation Technique - Results of the scent-station visitation technique indicate that the coyote (*Canis latrans*) and the weasel (*Mustela frenata* or *M. erminea*) are the most abundant mammalian predators in the Tract C-a area. They are the only predators that have responded to this survey technique.

The low level of response (an index of 19 for coyotes and 14 for weasels) in the November 1974 sample may be attributed to the fact that the sampling period immediately followed the mule-deer hunting season. There are two reasons that such a condition might affect scent-station data: (1) the animals would probably be more wary following a period of increased human activity, especially one which included firearm use; and (2) the animals would be less

likely to roam in search of food due to the availability of camp refuse, viscera from hunter kills, and the easy prey afforded by wounded deer (R. Krager, Colorado Division of Wildlife's Little Hills Experimental Station, personal communication, 1974).

Coyote response during February 1975 increased greatly (an index of 78) over the November sample and remains the highest of all four sampling periods, perhaps because the scarcity of food in the winter encouraged coyotes to roam farther and encounter more stations. Response during June and October 1975 was moderate for both sampling lines, with indices ranging between 26 and 47 for coyotes and between 26 and 35 for weasels.

The scent-station visitation technique is not designed as a method for determining mammalian predator densities. However, the technique may be applied as an index of relative abundance and, as with all indices, the greater the sample size, the greater the certainty of an accurate index. For this reason, the sampling effort on Tract C-a was increased to two 50-station lines. Although this constitutes 100 scent-stations, the possibility of contagion (one animal visiting more than one station) between stations located only 0.5 km (0.3 mi) apart required that each line be considered as only one sample, thus strict statistical comparison between sampling lines cannot be made. However, a general comparison between the relative abundance indices calculated for the Tract C-a area (Table 3-7-212) and those indices calculated for federally-surveyed lines within similar habitats with similar physiographic characteristics (Table 3-7-213) illustrates the range of variation in data--both between sampling lines and from year to year--and shows that the data from Tract C-a fall within this range.

The scent-station visitation technique is presently undergoing research to determine its sensitivity in limited areas and, perhaps with modification, its possible application as a technique that will provide density estimates (Robert Roughton, United States Fish and Wildlife Service, personal communication, 1975).

b) Coyote Siren Census - Results of the siren-elicited howling response survey are moderately consistent for most of the samples taken thus far with station-response indices ranging between 40 and 67, and three of the four group response indices ranging between 87 and 100. The group-response index of 40 for the October 1975 sample may be low because of the limited sample size during that period. This technique appears to be working satisfactorily and should prove valuable as an alternate indicator of relative coyote abundance over a period of time. The nature of the results obtained with this method during November 1974 serve to support the hypothesis that coyote numbers were not reduced as indicated by the scent-station survey, but that the animals were less likely to approach scent-stations immediately following the mule-deer hunting season.

June 1975 was the only sampling period thus far when all 10 siren stations were accessible for two nights. Snow and snow-packed conditions have prohibited complete sampling in all other samples.

c) Other Large Predator Investigations - Records of mammalian predator sightings during large mammal and raptor aerial surveys, as well as field observations during the course of other field investigations, are being compiled; and distribution maps summarizing these data will be presented in the final report.

Efforts to locate past records of abundance and distribution of mammalian predators, records of damage claims to livestock, hunting kill, and trapping records of predatory mammals specific to the area have been unsuccessful. Many individuals from various federal and state agencies have been contacted in an attempt to acquire this information, but it appears, at this point at least, that such records were either poorly kept, misplaced or simply non-existent. However, further efforts will hopefully yield this information.

d) Small Predators - The limited qualitative Havahart live-trapping program has yielded two species of small predators, the long-tailed weasel (*Mustela frenata*) and the short-tailed weasel (*M. erminea*).

Observations of these mammalian predators are plotted on field maps and distribution maps summarizing all mammalian predator observations will be presented in the final report.

4. Discussion - Records of tracks, scats, and other definitive signs recorded by ECI personnel on and near Tract C-a, as well as the results of the scent-station visitation survey and winter track counts, indicate that the coyote (*Canis latrans*), the long-tailed weasel (*Mustela frenata*), and the short-tailed weasel (*M. erminea*) are the most abundant mammalian predators in Tract C-a area. Coyote relative abundance indices are generally near the midpoint of the range of variation exhibited by federally-surveyed lines within similar habitats with similar physiographic characteristics and seem to indicate that coyote populations are about average for the region.

Other mammalian predators that have been documented in the study are the bobcat (*Lynx rufus*) and the badger (*Taxidea taxus*).

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Figures and Tables for the

Mammalian Predators Section

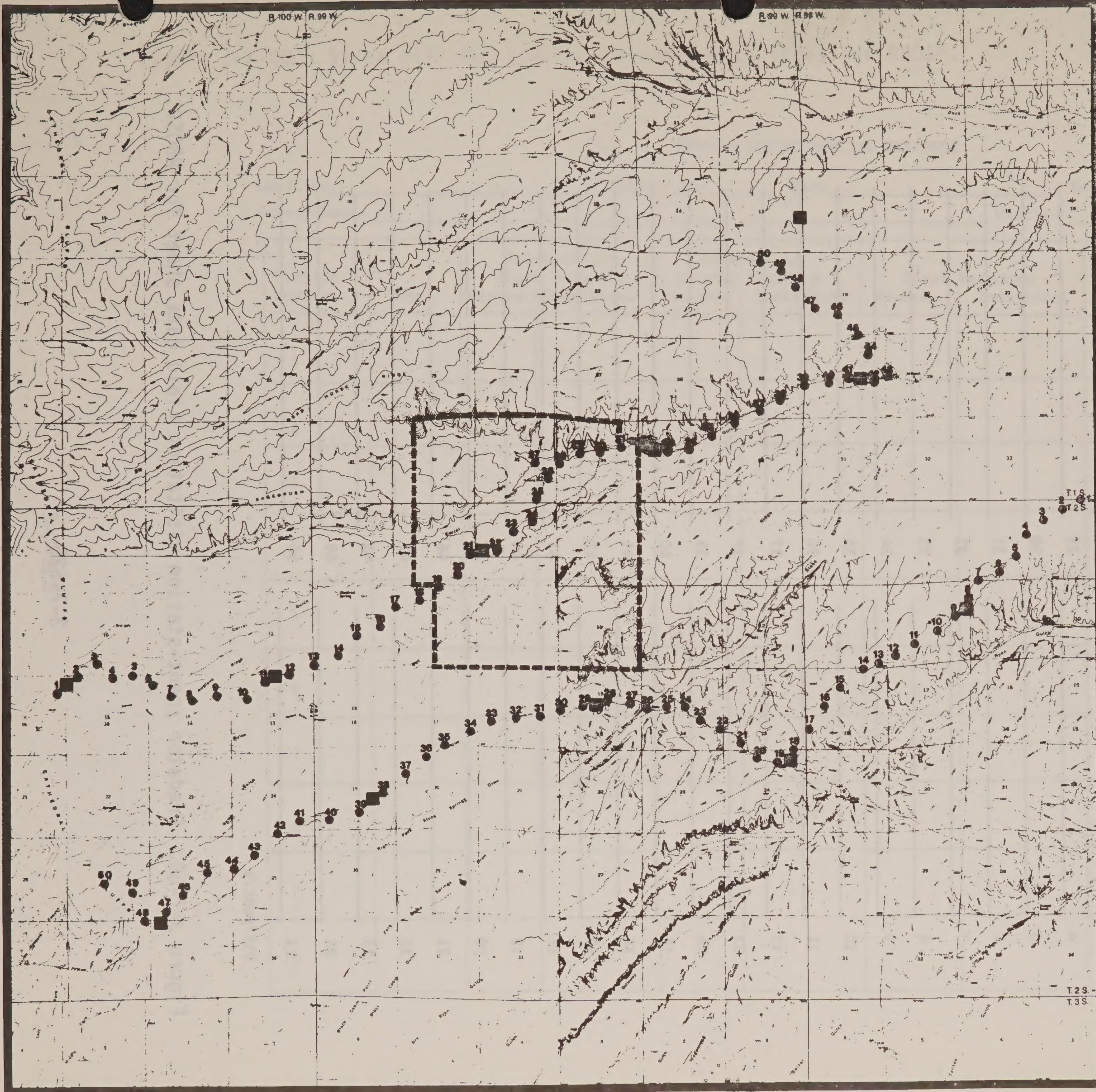

Figure 3-7-58

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

MAMMALIAN PREDATOR SAMPLING LOCATIONS

- ● predator scent-stations
- ■ coyote siren census stations

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

PREDATOR SCENT-STATION VISITATION FIELD DATA SHEET

ecology consultants, inc.

Location________________ Proj. No. ________ Date__________ Day # ______

Investigator __________________ Survey Route __________________

__________________ Weather __________________

1		26	
2		27	
3		28	
4		29	
5		30	
6		31	
7		32	
8		33	
9		34	
10		35	
11		36	
12		37	
13		38	
14		39	
15		40	
16		41	
17		42	
18		43	
19		44	
20		45	
21		46	
22		47	
23		48	
24		49	
25		50	

059/060175

Figure 3-7-59. Predator scent-station visitation field data sheet for RBOSP.

Figure 3-7-60. Siren elicited howling response data sheet for RBOSP.

ecology consultants, inc.

SIREN-ELICITED HOWLING RESPONSE

Location______________________ Project No.________ Date____________________ Investigators____________________

Survey Route____ Weather____________________________

Station Number	Time	Response to First Sounding		Response to Second Sounding		Total Response		Notes on conditions affecting data; wind; proximity to humans, etc.
		Groups	Individual	Groups	Individual	Groups	Individual	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Figure 3-7-61. Mammalian predator investigation data summary and analysis form for RBOSP.

ecology consultants, inc.

PREDATORS - DATA SUMMARIZATION AND ANALYSIS

Location:__________________________ Project:________ Sample Date:__________ Analysis Date:_________ Analyst:_____________

SCENT-STATION VISITATION INDEX

	1	2	3	4	5	TOTAL
Operable Stations:						
Visits by Species:						

$$\frac{\text{TOT. NO. OF VISITS BY SPECIES}}{\text{TOT. NO. OPERABLE STATION NIGHTS}} \times 1{,}000 = \text{INDEX}$$

Index by Species:

SIREN-ELICITED HOWLING RESPONSE

No. of Stations	No. Stat. w/Resp.	No. of Groups Resp.

$$I_s = \frac{\text{TOT. NO. STATION WITH RESPONSE}}{\text{TOT. NO. OF STATIONS}} \times 100$$

I_s = ____________________

$$I_g = \frac{\text{TOT. NO. OF GROUPS RESPONDING}}{\text{TOT. NO. OF STATIONS}} \times 100$$

I_g = ____________________

I_s = Station Response Index

I_g = Group Response Index

060/060175

Table 3-7-212. Scent-station visitation technique results and relative abundance indices as calculated from data collected during November, 1974 and February, June and October, 1975 for RBOSP

	Nov. 1974	Feb. 1975	June 1975A	June 1975B	Oct. 1975A	Oct. 1975B
Operable Station Nights	211	166	228	172	187	193
Coyote index	19	78	26	35	37	47
No. of visits	4	13	6	6	7	9
Weasel index	14	12	26	35	27	26
No. of visits	3	2	6	6	5	5

Table 3-7-213. Scent-station visitation technique results and relative abundance indices from federally-surveyed lines within generally similar habitats with similar physiographic characteristics (1973-1975) as those sampled for RBOSP

Colorado

	1973			1974			1975*		
Survey line number	14	17	18	14	17	18	14	17	18
Operable station nights	250	250	250	248	191	239			
Coyote index	148	96	28	48	26	54			
Number of visits	37	24	7	12	5	13			

Utah

	1973			1974			1975*		
Survey line number	15	16	17	15	16	17	15	16	17
Operable station nights	200	199	250	140	192	250			
Coyote index	60	45	20	7	26	164			
Number of visits	12	9	5	1	5	41			

* Data not yet received.

Table 3-7-214. Coyote siren census results and station and group response indices calculated from data collected November, 1974 and February, June and October, 1975 for RBOSP

Number of Stations	Number of Responding Stations	Number of Responding Groups	Station Response Index *	Group Response Index**
		Sample 1 (November, 1974)		
15	10	13	67	87
		Sample 2 (February, 1975)		
11	7	10	64	91
		Sample 3 (June 1975)		
20	10	20	50	100
		Sample 4 (October, 1975)		
10	4	4	40	40

$$* \quad \text{Station Response Index} = \frac{\text{Total number of stations with response}}{\text{Total number of stations}} \times 100$$

$$** \quad \text{Group Response Index} = \frac{\text{Total number of groups responding}}{\text{Total number of stations}} \times 100$$

D. AVIFAUNA

1. Objectives - The purposes of the avian census program are to identify the bird species that occur within the study area on a seasonal and annual basis, to determine for principal species their density in and use of dominant habitats, and to develop an objective designation of important species. The importance of an avian species may be determined by demonstrating its recreational or economic value; threatened, rare or endangered status; esthetic value; or critical role in the structure and function of the ecosystem. Favored nesting habitats of breeding species are to be indicated.

2. Methods

a. Data Collection

1) General Avifauna - Population densities of songbirds and certain non-songbirds residing in or utilizing major vegetation types on Tract C-a and adjacent areas are being determined by the strip transect method developed by Emlen (1971). These quantitative censuses commenced in early October, 1974 and will continue through August, 1976. Fifteen habitats are being censused for species composition and abundance during nine field periods (October, December, 1974; February, April, June, October, 1975; February, April, June, 1976). All transects except a riparian census route either start at or traverse one of the 14 small mammal live-trapping grids (Figure 3-7-27).

At each of the 15 census sites, a strip transect procedure is being used to provide data from which bird densities can be calculated. The particular technique employed consists of slowly walking through a strip approximately 800 m (2,624 ft) long and 244 m (800 ft) wide; all individual birds seen and heard within this strip are recorded by species on a standard field data form according to their perpendicular distance from the transect at the time of initial observation. Perpendicular distances are recorded according to categories of 0-3 m (0-10 ft), 3-7.6 m (10-25 ft), 7.6-15.2 m (25-50 ft),

15.2-30.5 m (50-100 ft), 30.5-61 m (100-200 ft), and 61-122 m (200-400 ft). A hand-held rangefinder was used initially to "calibrate" the observer to these distance zones. The length of each transect was determined by measuring a plot of the route on USGS 7.5 minute topographic maps, and converting the length to meters.

Strip transect censuses are conducted during periods of peak activity, generally within 3.5 hours of sunrise and sunset.

Strip transect techniques are time consuming and are employed to obtain quantitative baseline data which will form the norm for future comparisions. To be useful for such comparative applications, the strip transect method is restricted to relatively homogeneous blocks of habitat. Species which prefer mixed or "edge" habitats, or species occupying very limited patches of specialized habitat, cannot be effectively surveyed by strip transect techniques. Edge habitats and small but unusual habitat patches were inventoried by qualitative censuses to achieve a more complete inventory of bird species which utilize the full range of Tract C-a habitats. Such qualitative observations thus satisfy an inventory role, whereas strip transect data satisfy a baseline establishment role. Because of coverage of a diverse spectrum of habitats, more species are usually encountered in qualitative surveys than quantitative counts.

Qualitative count surveys are conducted during each general bird sampling period. Such surveys consist of walking a route in a given vegetation type approximately 250 m (820 ft) long, and recording all birds encountered, by species and numbers, on a data form. Quantification in these surveys is less rigorous than in standard strip transect censuses, and they may be conducted during mid-day periods of lower bird activity. Thus, quantitative comparisons between qualitative surveys performed at different sites or times, or between qualitative and strip transect censuses, are usually not reliable. Nonetheless, qualitative surveys serve important functions: they promote more complete assessment of avian diversity in each vegetation type, provide a more complete qualitative rendition of species distributions, and develop a more thorough inventory of species inhabiting the Tract C-a vicinity.

Nest surveys are conducted to provide supplemental information on which species breed in the area and their specific habitat preferences. When an active nest is discovered during any field activity, the nest is examined and the species, nest type, nest substrate, rim height of nest, nest location in relation to nearby landmarks, and nest contents are recorded on a field data sheet.

Strip transect surveys are not interrupted to obtain data on nests. This reduces the possibility of recording birds already tallied. Rather, the nest's location is marked with surveyor's flagging tape and examined after the strip transect census is completed. Nests discovered during qualitative counts and upland gamebird, waterfowl, and raptor investigations are examined upon discovery.

2) Upland Gamebirds - The locations of sage grouse seen during strip transect censuses and observations made during any terrestrial field investigation, including aerial surveys, help identify possible locations of sage grouse leks (strutting grounds). These locations are plotted on maps and designated as sites of potential nesting, since approximately 80% of all sage grouse nests are found in association with the sagebrush vegetation type and within a 5.65 km (3.5 mi) radius of a strutting ground (Gill, 1965; Martin, 1970; Autenrieth, 1969, 1970).

To gauge sage grouse nesting success, a 20-mile brood census route through sagebrush habitat (Patterson, 1952; Rogers, 1964) is being traversed on roads through Tract C-a and adjacent areas on two consecutive mornings during mid-July 1975 and 1976 (Figure 3-7- 62). The census route is traversed in a 4-wheel drive vehicle driven at less than 32 km (20 mi) per hour. Encountered sage grouse are flushed and tallied according to sex and age. Criteria for sexing and aging are based on data presented by Rogers (1964).

Blue grouse favor open conifer-aspen stands or areas where aspen and shrubs are intermixed (Rogers, 1968). In the study area, these vegetation types are found only on the slopes of Cathedral Bluffs. On two consecutive mornings during May, 1975 and 1976, a 24.2 km (15 mi) route traversing these habitats

(Figure 3-7- 62) is travelled to count blue grouse and to determine areas of concentration. These surveys commence at daybreak and continue for 3 hours after sunrise. Stops are made at each appropriate vegetation site, and all grouse heard displaying are recorded. The survey period represents the height of the blue grouse display season (Rogers, 1968; Mussehl, 1969).

Audible detection of either hooting or flutter display activity is used in addition to sightings to indicate the presence of blue grouse. Display locations are plotted on site maps and identified as probable nesting areas for this species. These areas are revisited during August; at this time, all flocks located are flushed and young-to-adult ratios recorded.

Density of mourning doves, breeding inhabitants of almost all vegetative communities on Tract C-a and vicinity, is determined from strip transect counts and subsequent calculations.

3) Waterfowl - Waterfowl were censused during October, 1974 and April, June, and August, 1975. During each census period, the Stake Springs Draw impoundment (NW 1/4, Section 14, T 2S, R99W) was visited during morning, mid-day, and early evening for a minimum of 2 days to determine the extent of utilization by migratory or breeding waterfowl. Observations were made from a position approximately 200 m (656 ft) south of the impoundment. This vantage provides good visibility and minimizes disturbance of waterfowl by the observer. The pond is observed for approximately 15 minutes during each of the three visits. Each bird observed on the pond is identified to species, and the number of individuals per species is recorded on a standard field data form. In addition to geese and ducks, shorebird use of the pond is also determined.

4) Raptors

a) Aerial Surveys - Raptorial birds include the vultures, hawks, eagles, falcons, and the owls. The common raven is also included in this category, due to its similar ecological role (Craighead and Craighead, 1969).

Low-level aerial surveys are being conducted to determine relative abundance and distribution of raptors utilizing or residing in the vicinity of Tract C-a. These flights were initiated in November, 1974 and have continued in conjunction with bimonthly mule deer, elk, feral horse, and domestic livestock aerial surveys. Flights are conducted in a high-winged aircraft designed to permit slow flight speeds at low levels above the ground. The plane is flown along standardized transects (Figure 3-7- 63) at an indicated air speed of 137.1 - 153.2 km (85-95 mi) per hour and at an altitude of approximately 60 m (196.8 ft), safety permitting. During successive census flights, the flight paths (transects), speed, and altitude of the aircraft are duplicated as closely as weather conditions allow.

Portable tape recorders are used to record information, thereby permitting continuous observation of the transect. Prior to the census, the types of general information described for big game censuses are identified on the tape. Raptors seen by the pilot and two observers (positioned on opposite sides of the plane) are located and identified as to species and, when possible, age class. Subsequent to the flight, all information recorded on the tape is transcribed by each observer onto a standard aerial raptor census report and summary form.

Aerial surveys cover Tract C-a and adjacent areas as illustrated on Figure 3-7- 63. Each aerial survey consists of 14, 17.7 km (11 mi) transects and systematically covers Tract C-a and adjacent areas. Odd-numbered transects are flown from north to south and even-numbered transects are flown in the opposite direction. Each successive pass is flown approximately 1.6 km (1.0 mi) from the previous transect, as mapped.

Although raptor surveys occur on the same days as mule deer, elk, feral horse, and domestic livestock aerial surveys, they are initiated after the ungulate surveys have been completed. This delay allows thermals, which are utilized by raptors for soaring and hunting, to develop. At times, censuses may be postponed or terminated due to adverse weather (low overcast, high winds, rain, snow, etc.). If a survey is aborted, it is conducted in its entirety after weather conditions become more favorable.

b) Ground Surveys - During late April and early June 1975 and 1976, potential raptor nesting habitats on Tract C-a and the surrounding area are traversed on the ground for four consecutive days. Raptors noted during these and any other avian field activities are recorded as to species, age class (based on criteria developed by Bent, 1961; Peterson, 1947, 1961; and Brown and Amadon, 1968), and location of observation. All raptor nests (active or inactive) encountered are carefully examined and their locations plotted on field maps. Photographs are taken of the nest site area. Nests located during the non-nesting period are revisited and watched for evidences of occupancy; the species occupying each active nest is determined.

Three specific portions of the study area are the focus of the concentrated nest search activities during April and June. The first area is Tract C-a proper. Eight separate north-south transects are walked; transect #1 originates at the northwest corner of Tract C-a and each successive transect begins approximately 0.53 km (0.33 mi) east of the previous one.

Major habitats surrounding Tract C-a comprise the second sampling area. An observer walks one, 4 km (2.48 mi) transect in each vegetation type to locate active nests.

The third sampling area includes the major drainage gulches and other small gullies which offer cliff-nesting potential. Areas where rock outcroppings and steep cliffs occur were determined by ground reconnaissance and analysis of aerial photographs of the Tract and surrounding area. This area includes the western slopes of Cathedral Bluffs, where golden eagles, peregrine falcons, and prairie falcons may nest.

During December 1974 and 1975, and April 1975 and 1976, a standardized road transect is traversed at night to assess owl activity. These surveys commence within 2 hours after sunset. The road transect consists of 30 stops, each permanently marked with a stake and flagging tape, located approximately 1.6 km (1.0 mi) apart (Figure 3-7- 64). Length of the transect is 48.4 km (30 mi). At each stop, the observer leaves the vehicle, walks approximately 15 m (50 ft) away, and records on a data sheet, by species, the number of owls heard or

observed during a 5-minute period. Criteria for determining owl species by vocalizations are based on the observer's experience, tape recordings of various species, and information presented by Peterson (1947, 1961), Bent (1961), Craighead and Craighead (1969), Thorpe (1961), and Armstrong (1973).

b. Data Analysis

1) Population Density Estimates - Estimations of population density for species observed on strip transects are determined by one of three methods (Emlen 1971), depending on the conspicuousness of the species to the observer. Since the validity of any of these methods varies for different species, professional judgment, based on experience with the noticeability of various species within different habitats during different seasons, is used in selecting the best density estimator. As an illustration of the procedures of density estimation utilized for strip transect data by the three methods discussed below, a sample problem is provided in Figure 3-7-65.

For species which are associated with distinctive habitat types, are conspicuous, and occupy large activity areas, Method "A" usually provides the best density estimate. This method assumes that, because of their conspicuousness and activity, all individuals occupying the strip transect area are tallied by the observer. Thus, the method simply involves division of the total number of individuals seen on the transect by the total area of the transect to obtain estimates of number per km^2. To determine number per hectare (#/ha), a factor of 0.1 is multiplied by the number of birds observed.

Method "B" recognizes that most species become less and less conspicuous over distance and therefore have a decreasing probability of being recorded with increasing distance from the transect route. Thus, a coefficient of detectability (C.D.), the proportion of a species' population which is ordinarily detected by an observer, is used to adjust the estimate obtained by Method "A". The coefficient of detectability is determined directly from data on the distribution of detection points perpendicular to the transect route. The transect route bisects the sampling area, which is divided into a series of strips parallel to the central route. The strip widths, presented

FIGURE 3-7-65

SAMPLE PROBLEM FOR STRIP TRANSECT DENSITY ESTIMATION FOR RBOSP

DATA ANALYSIS - STRIP CENSUSES

Species: 645 Green-tailed towhee Dates: December 1974

Site: 2-Sagebrush Comments:

Project:

COUNT RESULTS SUMMARIZED:

Individuals Observed

Date	0-10'	10-25'	25-50'	50-100'	100-200'	200-400'	Σ
12/74	2	3	5	1	2	0	13
Σ	2	3	5	1	2	0	13

Basal Plateau Level: 10 Projected Census: 80 Strip Width: 244 m

Total length of census strip (m): 800 $C.D. = \frac{\text{Observed}}{\text{Projected}} =$ 0.1625

Census Estimate:

A. Unadjusted: Strip Width (244 m) X Strip Length (800 m) = 195200 m^2

Number observed (13) X $\frac{10000}{195200}$ = 0.67 indiv/ha

B. Adjusted for C.D.: $\frac{\Sigma \text{ Observed/ ha}}{\text{C.D.}}$ = 4.1 indiv/ha

C. Adjusted for C D. and Basal Detectability: B.D. Adjustment = 1.2

Revised census: B.D. X Census Estimate B = 4.9 indiv/ ha

as distances from the central transect route, are listed under General Avifauna Data Collection. It is assumed that all individuals of a species observed in strips preceding and including the strip containing the greatest number of birds for that species represent the total number of birds present within those strips. This sum, termed the basal plateau level, is extrapolated to the limits of the entire census band [800 x 244 m (2,624 x 800 ft)] so that the resulting figure represents the projected number of birds for a species within the entire transect. The coefficient of detectability for the species is then determined by dividing the observed number of birds within the transect by the projected number. The C.D. thus represents the efficiency of the census for a particular species. Dividing the density estimates obtained in Method "A" by the coefficient of detectability provides an adjusted population density estimate (Emlen 1971).

When the assumption of complete censusing of birds of a species close to the transect route cannot be met, such as in instances of particularly shy or retiring species, Method "C" is employed for density estimation. This method involves multiplication of the estimate obtained in Method "B" by an additional adjustment factor, the basal detectability adjustment. This method adjusts for those species whose conspicuousness diminishes rapidly past some critical distance from the transect route; these birds may not be seen unless they flush nearly underfoot. Emlen (1971) suggested that the basal detectability adjustment should rarely exceed 1.2 for wintering birds and should average about 1.5 for breeding bird populations because of the inactivity of the females and the intermittent singing of the males. For those species warranting this correction, values of 1.2 and 1.5 were applied for wintering and breeding birds, respectively. Additional field experience will undoubtedly lead to refinements in these adjustment factors.

2) <u>Index of Relative Abundance</u> - Once a population density estimate is computed, it is used to determine the percent relative abundance (% RA) for each species. The % RA is defined as follows:

$$\% \text{ RA} \doteq \frac{\text{Density of species A}}{\Sigma \text{ density of all species}} \times 100$$

Since the projected number per hectare takes into account correction factors applied to the observed population count, in the case of strip transect data % RA is based on number per hectare rather than actual number observed. In the case of qualitative counts, % RA is based on actual numbers of individuals observed.

3) Species Diversity - Shannon-Weiner species diversity indices are calculated for each strip transect during each sampling period by the methods outlined in Section A.2.C (Data Analysis). However, the adjusted number of birds per transect (number observed ÷ coefficient of detectability x basal detectability adjustment) is used in the calculation rather than actual number observed. This method thus adjusts for the varying conspicuousness of different species.

4) Confidence Level of Data - A number of factors may influence the accuracy and utility of data used to calculate population abundances of animals. Certain factors are intrinsic to the field and data analysis methodologies employed; the best available methodologies incorporate routines or procedures which maximize data utility and interpretation. Other factors are determined by circumstances extrinsic to the sampling technique used. Extrinsic factors become especially influential in reducing the confidence one can place in data on abundance in situations where the studied organisms have capability for movement over long distances, or when behavioral traits cause population aggregations which lead to extremely patchy occupancy of satisfactory habitat.

Because birds are highly mobile and, during the non-breeding season, often exhibit extreme non-uniformity in their distribution patterns, density estimation becomes difficult; thus, it is often necessary to qualify the meaning of bird density values derived from even the best field census procedures. In the data summary section, occasional qualifications are made as deemed necessary. Here, a brief generic-level treatment of potential data limitations is presented.

a) Winter Mixed Flock Behavior - Commencing in late fall and continuing until early spring, many permanent and winter resident species of the Piceance Basin congregate in mixed-species flocks. These flocks are usually nonstationary; the individuals comprising them exploit food resources in a

very localized area for a few hours or, in the case of a rich food source, longer periods before moving en masse to another feeding or roosting location. The resultant pattern of distribution accounts for vast areas of a particular habitat remaining devoid of birds at a particular time, while other areas support dense congregations. Field data obtained during the winter period generally reflect the inconsistent pattern of habitat utilization caused by this dynamic behavior of winter flocks. Few or no birds will be tallied along some 0.8 km transects, while other transects which fortuitously include a mobile winter flock within the censused strip will tally a large number of individuals. Moreover, reduced visual and audible conspicuousness of individual birds that do not flock as compared to birds that do decreases their potential of being observed. Consequently, individual conspicuousness and flock conspicuousness will strongly influence the species which are recorded and their population numbers (Brewer, 1972), despite careful field work and application of coefficients of detectabilities. Add to these extrinsic factors the generalized habitat preferences exhibited by species of wintering birds, plus temporal avoidances by individuals and flocks of windswept habitats such as meadows, and the interpretation of population densities in a given habitat becomes clearly in need of qualification. Unfortunately, practical field techniques which can resolve these specific problems remain unavailable despite intensive efforts by field ornithologists to perfect them.

b) Migratory Behavior - Generally, during their migration species do not exhibit the well-defined habitat preferences and attachment to specific locations shown by them during the breeding season.

Results of censuses made during this period must thus be viewed with cognizance of certain basic characteristics of bird migration. During migration, many nocturnally migrating species stop their directional movement each morning and then feed and rest in loosely organized flocks; these flocks move along topographical features such as drainages or ridges. Similar to patterns exhibited by mixed winter flocks, bird distribution during periods of migration often is highly clumped or aggregated, and large areas of seemingly appropriate habitat support no birds at a given moment, while a

relatively small area may contain extremely high densities of birds. As a consequence, a series of bird density estimations determined over a sequence of migration periods must not be interpreted as providing data which are directly comparable for long-term trends.

Moreover, species composition within a region during migration is dynamic, as a wave of certain migrant species can quickly be replaced by a wave dominated by different species. Densities can also vary markedly from day to day during migration, as bird numbers increase in an area when poor weather stalls advance and decline abruptly when favorable weather conditions promote exodus. This dependency of migratory dynamics on weather conditions has been well documented (Curtis, 1969, 1970; Hassler, et al., 1963). The exact path which a flock of birds takes and, therefore, the location of a stopping point along the migratory route may also be determined by the extent to which the migrating flock is displaced by winds (Graber, 1968).

A consequence of avian population dynamics during migration is that migrant species' density values are of limited use--they represent an estimate of bird numbers at a single pulse in time and at a spatial scale entirely too small for logical treatment, since many species' migrant movements are actually of continental scale. Hence, census results by any method from periods of autumn and spring migration are not appropriately used as baseline data, but are, nonetheless, important to satisfying the requirement that an inventory be made of species utilizing tract habitats during migration.

c) Wide-Ranging Species - Most birds of prey range over wide areas during hunting activities. A single golden eagle, for instance, may traverse as much as 50 km^2 (20 mi^2) in the course of daily hunting. Such movements over large areas preclude effective estimation of population densities by any census method that is restricted to specific vegetative communities. Because strip transect data on most birds of prey are not amenable to density estimations, tallies of buteos, accipiters, falcons, and eagles made during transect censuses were excluded from calculations of bird densities at each of the 15 transects. Similarly, strip transects sightings of upland gamebirds other than the mourning dove, which during

the nesting season confines its activities to a relatively small territory, were also excluded from density calculations.

d) Aerially Feeding Species - Nighthawks, swifts, and swallows feed by capturing insects on the wing, so most tallies of these species involve observations of birds in flight. Because these species sometimes concentrate in areas of insect congregations, censuses of transects supporting such temporary concentrations tend to overestimate densities of these species. Overestimates of this nature result from all census techniques.

Based on conclusions from discussions presented in a) and b) above, density data derived from migration and winter periods must be carefully qualified. Conversely, because breeding birds exhibit tenacity to territories and are dispersed throughout their preferred habitat, quantitative data on certain permanent and summer resident species' densities obtained during the nesting period are reliable indicators of abundances, given qualifications indicated below which relate to intrinsic limitations of the specific strip transect methodology being employed.

e) Habitat Heterogeneity - Censuses aimed at establishing avian densities assume that the habitat being sampled is homogeneous and characteristic of the vegetative community of interest. The strip transect methodology employed in the tract vicinity requires a relatively large sampling area [800 x 244 m (2,624 x 800 ft)]. Careful placement of transects within large blocks of relatively homogeneous communities has minimized inclusion of multiple habitats within a single transect. Nonetheless, patches of dissimilar habitats resulting from plant responses to discontinuities in soil, moisture, slope, etc. are interspersed within most transects. These patches sometimes attract species which are not characteristic of the specific habitat being censused and, occasionally, such species are tallied during the census.

f) Overestimations from Single Sightings in Innermost Transect Strip - The extrapolation of basal plateau values to the entire transect width tends to produce overestimates of density when a species has been observed only once or twice, and sightings are confined to the strip closest to the transect route. To reduce the magnitude of such overestimations, sightings in the two innermost strips were combined for the purpose of calculating density.

3. Data Summary

a. General Avifauna - The status, occurrence, and preferred habitats of the 129 species which have been observed in the study area during the first year's investigations are listed in Table 3-7-215. Definitions of terms used to describe status and occurrence are presented in footnotes to this table.

The remainder of this section summarizes information derived from strip transect censuses at the 15 transect locations during the first year of the terrestrial investigations. Emphasis of the discussion focuses on species considered to be the most important in each habitat. Generally, species achieving greater than 10% relative abundance are considered here as "important". Other species attaining a lesser numerical abundance are also addressed in events where it is necessary to clarify data according to the discussion of Confidence Level of Data given earlier. Although some species mentioned below occur in more than one of the censused vegetation types, their ecological requirements are discussed only once.

Table 3-7-215

OCCURENCE, ANTICIPATED STATUS, AND HABITATS AT TIME OF OBSERVATION FOR BIRD SPECIES SEEN BETWEEN OCTOBER 1974 AND OCTOBER 1975 *

ORDER FAMILY (Species) Common Name	Occurrence**				Status **					Habitat at Time of Observation ***														
	Resident	Summer	Winter	Migrant	Common	Uncommon	Rare	Accidental	Uncertain	Aspen	Douglas fir	Upland Meadow	Mixed Brush (low elevation)	Mixed Brush (high elevation)	Pinyon-juniper (north slope)	Pinyon-juniper (south slope)	Pinyon-juniper/ Mixed Brush	Pinyon-juniper/ Sagebrush	Sagebrush (low elevation)	Sagebrush (high elevation)	Greasewood/ Sagebrush	Rabbitbrush	Riparian	Bottomland Meadow
CICONIIFORMES																								
ARDEIDAE																								
(*Ardea herodias*)																								
Great blue heron				X			X																X	
CICONIIDAE																								
(*Plegadis chihi*)																								
White-faced ibis				X			X																X	
ANSERIFORMES																								
ANATIDAE																								
(*Anas platyrhynchos*)																								
Mallard	X				X																		X	
(*Anas strepera*)																								
Gadwall		X				X																	X	
(*Anas crecca*)																								
Green-winged teal		X				X																	X	
(*Anas discors*)																								
Blue-winged teal		X				X																	X	
(*Anas cyanoptera*)																								
Cinnamon teal		X				X																	X	
(*Aythya americana*)																								
Redhead		X							X														X	
FALCONIFORMES																								
CATHARTIDAE																								
(*Cathartes aura*)																								
Turkey vulture		X					X								X	X								
ACCIPITRIDAE																								
(*Accipiter gentilis*)																								
Goshawk		X							X	X														
(*Accipiter striatus*)																								
Sharp-shinned hawk		X							X					X										
(*Accipiter cooperii*)																								
Cooper's hawk		X				X								X	X	X	X	X						
(*Buteo jamaicensis*)																								
Red-tailed hawk	X				X									X	X		X	X	X				X	X
(*Buteo swainsoni*)																								
Swainson's hawk				X					X															X
(*Buteo lagopus*)																								
Rough-legged hawk			X		X							X	X						X	X			X	X
(*Aquila chrysaetos*)																								
Golden eagle	X				X							X					X	X	X	X			X	X
(*Haliaeetus leucocephalus*)																								
Bald eagle			X				X																X	X
(*Circus cyaneus*)																								
Marsh hawk	X				X							X												X
FALCONIDAE																								
(*Falco mexicanus*)																								
Prairie falcon	X						X					X				X			X					X
(*Falco peregrinus*)																								
Peregrine falcon		X		X			X								X	X								
(*Falco columbarius*)																								
Merlin				X			X					X												
(*Falco sparverius*)																								
American kestrel	X				X										X	X	X	X	X	X	X	X	X	X
GALLIFORMES																								
TETRAONIDAE																								
(*Dendragapus obscurus*)																								
Blue grouse	X				X					X	X			X										
(*Centrocercus urophasianus*)																								
Sage grouse	X				X									X					X	X				
GRUIFORMES																								
GRUIDAE																								
(*Grus canadensis tabida*)																								
Greater sandhill crane				X					X										X					

ORDER / FAMILY / (Species) / Common Name	Occurrence: Resident	Summer	Winter	Migrant	Status: Common	Uncommon	Rare	Accidental	Uncertain	Habitat at Time of Observation: Aspen	Douglas fir	Upland Meadow	Mixed Brush (low elevation)	Mixed Brush (high elevation)	Pinyon-juniper (north slope)	Pinyon-juniper (south slope)	Pinyon-juniper/ Mixed Brush	Pinyon-juniper/ Sagebrush	Sagebrush (low elevation)	Sagebrush (high elevation)	Greasewood/ Sagebrush	Rabbitbrush	Riparian	Bottomland Meadow
GRUIFORMES																								
RALLIDAE																								
(Rallus limicola) Virginia rail		x					x																x	
(Porzana carolina) Sora		x					x																x	
CHARADRIIFORMES																								
CHARADRIIDAE																								
(Charadrius semipalmatus)' Semipalmated plover				x			x							x										
(Charadrius vociferus) Killdeer		x			x																		x	
SCOLOPACIDAE																								
(Capella gallinago) Common snipe		x				x																	x	
(Actitis macularia) Spotted sandpiper		x				x																	x	
(Tringa solitoria) Solitary sandpiper		x				x																	x	
(Tringa flavipes) Lesser yellowlegs				x			x																x	
(Numenius americanus) Long-billed curlew				x			x																x	
RECURVIROSTRIDAE																								
(Recurvirostra americana) American avocet		x				x																	x	
PHALAROPODIDAE																								
(Steganopus tricolor) Wilson's phalarope		x				x																	x	
COLUMBIFORMES																								
COLUMBIDAE																								
(Zenaida macroura) Mourning dove		x			x										x	x			x		x		x	x
STRIGIFORMES																								
STRIGIDAE																								
(Otus asio) Screech owl	x								x															
(Bubo virginianus) Great horned owl	x				x						x				x	x								x
(Glaucidium gnoma) Pygmy owl			x						x		x													
(Asio flammeus) Short-eared owl			x						x															x
CAPRIMULGIFORMES																								
CAPRIMULGIDAE																								
(Phalaenoptilus nuttallii) Poor-will		x			x								x	x					x	x	x	x		
(Chordeiles minor) Common night hawk		x			x										x	x	x	x						x
APODIFORMES																								
APODIDAE																								
(Aeronautes saxatalis) White-throated swift		x			x					x		x		x		x						x		
TROCHILIDAE																								
(Selasphorus platycercus) Broad-tailed hummingbird		x			x					x					x			x						
PICIFORMES																								
PICIDAE																								
(Colaptes auratus) Common flicker	x				x					x					x	x	x	x						
(Dendrocopos pubescens) Downy woodpecker	x					x				x	x													

Table 3-7-215
(CONTINUED)

ORDER FAMILY (Species) Common Name	Occurrence: Resident	Summer	Winter	Migrant	Status: Common	Uncommon	Rare	Accidental	Uncertain	Habitat at Time of Observation: Aspen	Douglas fir	Upland Meadow	Mixed Brush (low elevation)	Mixed Brush (high elevation)	Pinyon-juniper (north slope)	Pinyon-juniper (south slope)	Pinyon-juniper/ Mixed brush	Pinyon-juniper/ Sagebrush	Sagebrush (low elevation)	Sagebrush (high elevation)	Greasewood/ Sagebrush	Rabbitbrush	Riparian	Bottomland Meadow
PASSERIFORMES																								
TYRANNIDAE																								
(Sayornis saya) Say's phoebe		x			x																x	x		x
(Empidonax hammondii) Hammond's flycatcher		x							x		x													
(Empidonax wrightii) Gray flycatcher		x				x									x				x					
(Contopus sordidulus) Western wood pewee				x		x												x	x		x	x	x	x
ALAUDIDAE																								
(Eremophila alpestris) Horned lark	x				x							x							x	x				x
HIRUNDINIDAE																								
(Tachycineta thalassina) Violet-green swallow		x			x							x			x								x	x
(Iridoprocne bicolor) Tree swallow		x				x									x	x		x						x
(Stelgidopteryx ruficollis) Rough-winged swallow		x				x																	x	x
(Hirundo rustica) Barn swallow		x				x																	x	x
(Petrochelidon pyrrhonota) Cliff swallow		x			x																		x	
CORVIDAE																								
(Cyanocitta stelleri) Steller's jay	x				x						x													
(Aphelocoma coerulescens) Scrub jay	x				x								x			x	x	x	x	x	x	x		
(Pica pica) Black-billed magpie	x				x							x	x						x		x	x	x	
(Corvus corax) Common raven	x				x							x	x	x	x	x	x	x	x	x	x	x	x	x
(Corvus brachyrhynchos) Common crow				x					x															x
(Gymnorhinus cyanocephalus) Pinyon jay	x				x										x	x	x	x						
(Nucifraga columbiana) Clark's nutcracker	x				x					x	x					x	x	x	x					
PARIDAE																								
(Parus atricapillus) Black-capped chickadee	x				x					x	x													
(Parus gambeli) Mountain chickadee	x				x					x	x				x	x								
(Parus inornatus) Plain titmouse	x				x										x	x								
(Psaltriparus minimus) Bushtit	x					x											x	x				x		x
SITTIDAE																								
(Sitta carolinensis) White-breasted nuthatch	x					x									x									
(Sitta canadensis) Red-breasted nuthatch	x				x						x				x									
(Sitta pygmaea) Pygmy nuthatch			x				x					x												
CERTHIIDAE																								
(Certhia familiaris) Brown creeper				x			x								x									

Table 3-7-215
(CONTINUED)

ORDER FAMILY (Species) Common Name	Occurrence: Resident	Occurrence: Summer	Occurrence: Winter	Occurrence: Migrant	Status: Common	Status: Uncommon	Status: Rare	Status: Accidental	Status: Uncertain	Habitat at Time of Observation: Aspen	Douglas Fir	Upland Meadow	Mixed Brush (low elevation)	Mixed Brush (high elevation)	Pinyon-juniper/ (north slope)	Pinyon-juniper/ (south slope)	Pinyon-juniper/ Mixed brush	Pinyon-juniper/ Sagebrush	Sagebrush (low elevation)	Sagebrush (high elevation)	Greasewood/ Sagebrush	Rabbitbrush	Riparian	Bottomland Meadow
PASSERIFORMES																								
TROGLODYTIDAE																								
(Troglodytes aedon)																								
House wren		x			x					x	x		x	x	x				x					
(Salpinctes obsoletus)																								
Rock wren		x				x													x		x	x		
MIMIDAE																								
(Oreoscoptes montanus)																								
Sage thrasher		x				x															x			
TURDIDAE																								
(Turdus migratorius)																								
American robin		x			x						x		x		x				x		x	x		x
(Catharus guttata)																								
Hermit thrush		x				x					x				x									
(Sialia currocoides)																								
Mountain bluebird		x			x							x	x	x	x	x	x	x	x	x	x	x	x	x
(Myadestes townsendii)																								
Townsend's solitaire			x			x				x														
SYLVIIDAE																								
(Polioptila caerulea)																								
Blue-gray gnatcatcher		x			x								x				x	x	x		x	x	x	
(Regulus calendula)																								
Ruby-crowned kinglet	x					x				x	x													
MOTACILLIDAE																								
(Anthus spinoletta)																								
Water pipit		x					x																x	x
BOMBYCILLIDAE																								
(Bombycilla cedrorum)																								
Cedar waxwing				x				x				x												
LANIIDAE																								
(Lanius excubitor)																								
Northern shrike			x			x													x		x	x	x	x
(Lanius ludovicianus)																								
Loggerhead shrike				x				x																x
STURNIDAE																								
(Sturnus vulgaris)																								
Starling				x	x																		x	x
VIREONIDAE																								
(Vireo vicinior)																								
Gray vireo		x				x										x								
(Vireo solitarius)																								
Solitary vireo		x				x									x	x								
(Vireo olivaceus)																								
Red-eyed vireo		x						x		x														
(Vireo gilvus)																								
Warbling vireo		x			x					x														
PARULIDAE																								
(Vermivora peregrina)																								
Tennessee warbler		x						x		x														
(Vermivora celata)																								
Orange-crowned warbler		x				x				x													x	
(Vermivora virginiae)																								
Virginia's warbler				x			x																x	
(Dendroica petechia)																								
Yellow warbler		x					x								x									
(Dendroica coronata)																								
Yellow-rumped warbler		x			x														x		x	x	x	x
(Dendroica nigrescens)																								
Black-throated gray warbler		x			x										x	x								
(Oporornis tolmiei)																								
MacGillivray's warbler		x			x					x				x										
PLOCEIDAE																								
(Passer domesticus)																								
House sparrow	x								x															

Table 3-7-215
(CONTINUED)

ORDER FAMILY (Species) Common Name	Occurrence: Resident	Occurrence: Summer	Occurrence: Winter	Occurrence: Migrant	Status: Common	Status: Uncommon	Status: Rare	Status: Accidental	Status: Uncertain	Habitat at Time of Observation: Aspen	Douglas Fir	Upland Meadow	Mixed Brush (low elevation)	Mixed Brush (high elevation)	Pinyon-juniper (north slope)	Pinyon-juniper (south slope)	Pinyon-juniper/ Mixed Brush	Pinyon-juniper/ Sagebrush	Sagebrush (low elevation)	Sagebrush (high elevation)	Greasewood/ Sagebrush	Rabbitbrush	Riparian	Bottomland Meadow
PASSERIFORMES																								
ICTERIDAE																								
(Dolichonyx oryzivorus) Bobolink		x					x																	x
(Sturnella neglecta) Western meadowlark		x			x																		x	x
(Angelaius phoeniceus) Red-winged blackbird		x			x																		x	x
(Euphagus cyanocephalus) Brewer's blackbird		x			x																		x	x
(Molothrus ater) Brown-headed cowbird		x					x								x									
THRAUPIDAE																								
(Piranga ludoviciana) Western tanager		x					x						x											
FRINGILLIDAE																								
(Pheucticus melanochephalus) Black-headed grosbeak		x					x			x														
(Carpodacus cassinii) Cassin's finch		x					x				x	x											x	
(Carpodacus mexicanus) House finch	x								x															x
(Leucosticte astrata) Black-rosy finch			x			x							x								x			
(Leucosticte australis) Brown-capped rosy finch			x			x							x								x			
(Spinus pinus) Pine siskin		x				x					x												x	
(Loxia curvirostra) Red crossbill		x				x					x													
(Chlorura chlorura) Green-tailed towhee		x			x								x				x	x	x		x	x	x	
(Pipilo erythrophthalmus) Rufous-sided towhee		x				x				x							x	x				x		
(Calamospiza melanocorys) Lark bunting		x					x													x				x
(Ammodramus savannarum) Grasshopper sparrow		x						x							x									
(Pooecetes gramineus) Vesper sparrow		x			x							x	x					x	x		x			x
(Chondestes grammacus) Lark sparrow		x				x												x	x		x			
(Amphispiza belli) Sage sparrow		x				x												x	x	x				
(Junco hyemalis) Dark-eyed junco			x	x	x					x	x		x	x	x		x				x	x	x	
(Junco caniceps) Gray-headed junco	x				x					x	x		x	x	x						x	x	x	
(Spizella arborea) Tree sparrow			x			x															x	x		x
(Spizella passerina) Chipping sparrow		x			x										x	x					x			
(Spizella breweri) Brewer's sparrow		x			x							x	x	x	x		x	x	x	x	x	x	x	x
(Zonotrichia leucophrys) White-crowned sparrow		x			x							x									x	x	x	x
(Zonotrichia atricapilla) Golden-crowned sparrow				x					x													x		

Table 3-7-215
(CONTINUED)

ORDER FAMILY (Species) Common Name	Occurrence				Status					Habitat at Time of Observation														
	Resident	Summer	Winter	Migrant	Common	Uncommon	Rare	Accidental	Uncertain	Aspen	Douglas-fir	Upland Meadow	Mixed Brush (low elevation)	Mixed Brush (high elevation)	Pinyon-juniper (north slope)	Pinyon-juniper (south slope)	Pinyon-juniper/ Mixed brush	Pinyon-juniper/ Sagebrush	Sagebrush (low elevation)	Sagebrush (high elevation)	Greasewood/ Sagebrush	Rabbitbrush	Riparian	Bottomland Meadow
PASSERIFORMES																								
FRINGILLIDAE																								
(Passerella iliaca)																								
Fox sparrow				x			x																x	
(Melospiza melodia)																								
Song sparrow		x			x								x						x		x	x	x	x
(Calcarius mccownii)																								
McCown's longspur			x					x				x												
(Calcarius ornatus)																								
Chestnut-collared longspur		x						x				x												
(Plectrophenax nivalis)																								
Snow Bunting			x					x						x										

* The following authorities are used for bird nomenclature:

American Ornithologists' Union, 1957. Checklist of North American Birds, Fifth edition. Port City Press, Baltimore, Maryland. 691 pages.

American Ornithologists' Union, 1973. Thirty-second supplement to the American Ornithologists' Union checklist of North American Birds (Fifth edition, 1957). Auk 90:411-419.

** Definitions of terms used to describe the status and occurrence of species listed in this table:

Occurrence (based on observations during first year, and supplemented where necessary by literature accounts).

Resident:	A species present during all seasons.
Summer Resident:	A species present throughout the summer; and assumed to nest in the region.
Winter Resident:	A species present during winter only.
Migrant:	A species stopping temporarily in the study area during its northward migration in the spring and its southward migration in the fall.

Status (based on observations during first year).

Common:	A species noted regularly in its normal habitat at the proper season of the year.
Uncommon:	A species of regular occurrence in small numbers, at the proper season of the year, but not likely to be observed on every census.
Rare:	A species present in small numbers, and noted only seldomly in proper habitat.
Accidental:	A species which is a casual visitor, and outside its normal range.
Uncertain:	A species whose status needs confirmation.

*** All habitats in which a species has been sighted during quantitative and qualitative censuses are marked for each species. As more sightings are made for wide-ranging species and for species which have generalized habitat responses, additional habitats can be checked.

1) Aspen (Transect #14) - From October, 1974 through October, 1975, the aspen transect (north slope/8,100 ft) was surveyed five times during four seasons. The aspen transect could not be censused during December, 1974 because of adverse weather conditions. Twenty-one species were recorded in the aspen vegetation type over all sampling periods (Tables 3-7-242 and 3-7-243). On an annual basis, mountain chickadees and gray-headed juncos were the most abundant species recorded. (The mountain chickadee nested in this habitat; the gray-headed junco was the principal species observed during spring and fall migration periods.)

During the two fall censuses, six different species were recorded on transects in the aspen vegetation type. Thirteen individuals, representing four species, were recorded during October, 1974, and 11 individuals, representing four species, were recorded during October, 1975. The gray-headed junco and mountain chickadee were the most abundant species present during both fall sampling periods. The gray-headed junco is a common resident on Colorado's western slope (Davis, 1969). During winter, it occurs in small flocks at elevations below 8,000 ft, where it often mixes with other species and exploits food resources on brushy hillsides or in weed patches (Baily and Niedrach, 1965). During summer, gray-headed juncos migrate to elevations between 8,000 and 11,000 ft (Baily and Niedrach, 1965). This junco has only been recorded in small flocks in the aspen type during the migratory seasons, when it associates with black-capped chickadees, mountain chickadees, and dark-eyed juncos (spring), and with the two chickadee species during fall.

The mountain chickadee and black-capped chickadee are typical residents of the aspen community in western Colorado and eastern Utah (Twomey, 1942; Bailey and Niedrach, 1965). The mountain chickadee is a partial altitudinal migrant, with most migratory individuals being immature birds (Dixon and Gilbert, 1964). Although only black-capped chickadees have been observed along the aspen transect throughout the year, it is probable that adult mountain chickadees also are permanent residents.

In addition to the two chickadee species, broad-tailed hummingbirds and ruby-crowned kinglets are characteristic nesting species in this vegetation type.

Ruby-crowned kinglets nest throughout the sub-alpine zone in Colorado, usually placing their nests in evergreens. Occasionally this species nests in high altitude, deciduous forests (Bent, 1964a; Davis, 1969). The broad-tailed hummingbird arrives in the region during the first weeks of May and remains into September. This species is usually most abundant in mountainous transition zones (Bailey and Niedrach, 1965). Downy woodpeckers and common flickers also nested in the aspen type in low numbers. Both species winter in lower valleys (Bailey and Niedrach, 1965).

During the breeding season, the aspen transect supported 16 species that were fairly equitably distributed compared with other transects surveyed (Table 3-7-250). A decline in species diversity occurred during the migratory periods (Tables 3-7-246, 3-7-249, 3-7-251). During autumn, this was partially due to the high outflow of breeding species and the low influx of wintering species in the study area. Transient occurrences of migrant flocks prevents meaningful interpretation and comparisions of migration period diversity indices. During winter, the aspen type supported few species. Because an overwhelming preponderance of individuals belonged to a single species, equitability was very low (Table 3-7-248).

2) Douglas-fir (Transect #13) - From October, 1974 through October, 1975, the Douglas-fir (northern slope/8,100 ft) strip transect was surveyed five times during four different seasons. The Douglas-fir transect could not be censused during December, 1974 because of inclement weather. One hundred sixty-six birds, representing 18 species, were recorded (Tables 3-7-240 and 3-7-241). The mountain chickadee and red-breasted nuthatch tended to be the most abundant resident species.

During the two fall sampling periods, 34 individuals of 10 different species were recorded in this vegetative type. Twenty-one individuals, representing 5 species, were recorded during October, 1974, while 14 individuals, representing 7 species, were recorded during October, 1975. The October species composition exhibited considerable variation from year to year, yet total community densities were similar (Table 3-7-240 and 3-7-241). The downy woodpecker and gray-headed junco were the only species encountered during

both October sampling periods. Most birds tallied in the fall censuses were species which either had nested in this vegetation type but had not departed by the time of the census or were migrants. The most abundant species encountered during the October, 1974 sampling period were the gray-headed junco, dark-eyed junco, and ruby-crowned kinglet. Percent relative abundance values for the gray-headed junco were similar for both fall censuses. The robin and gray-headed junco contributed 74.9% of the relative avian abundance within the Douglas-fir transect during October, 1975. The high density and percent relative abundance calculated for the robin is considered an overestimate caused by extrapolation from a single sighting close to the central transect site. Nonetheless, this species is expected to occasionally appear in abundance in this vegetative type during migration periods. The robin is an ubiquitous species, occurring in most vegetation types within the study area during the breeding season, including Douglas-fir. It has not been observed during the winter, but stragglers from the north are known to winter in Colorado (Bailey and Niedrach, 1965). Davis (1969) refers to the robin as a common resident in western Colorado's forests and towns.

Large intermixed flocks of black-capped chickadees, mountain chickadees, red-breasted nuthatches, and pygmy nuthatches were observed in the Douglas-fir vegetation type during February. These passerines are commonly associated with western coniferous forests (Twomey, 1942; Davis, 1969). This transect supported the densest population of any of the transects sampled during February (Table 3-7-240). The disparity between the high density of birds on this transect and the low population density in the closely associated aspen stands is probably attributable to clumped distributions of winter flocks at the time of sampling.

The mountain chickadee and black-capped chickadee continued to be dominating species during the April, 1975 sampling period. By April, winter flocks had dissolved and birds of species which ultimately nested in the area were more evenly distributed throughout the coniferous vegetation type. Mountain chickadee and red-breasted nuthatch densities appeared to decline considerably

between February and April. These changes were probably a consequence of winter flock dispersal to surrounding habitats with the advent of territorial establishment rather than of an actual decline in regional populations.

The Douglas-fir stand exhibited the highest species diversity index of any transect for June 1975 (Table 3-7-250). This high diversity was attributed to a large number of species (12) which were present in almost equal numbers. No single species was dominant during the breeding season. Red crossbills, pine siskins, red-breasted nuthatches, and mountain chickadees, however, were more numerous than the other species during June, but Stellar's jays, ruby-crowned kinglets, and gray-headed juncos also attained relatively high densities. These species are generally associated with coniferous forests during the breeding season (Twomey, 1942; Bailey and Niedrach, 1965). The red-breasted nuthatch is the only species that was recorded year-round in the Douglas-fir vegetation type. This species' preferred habitat is the evergreen - aspen association ranging from the transition zone to timberline. Although red-breasted nuthatches are migratory, their movements are not predictable. Depending on the severity of the winter, individuals of this species may move south, or they may remain within their breeding range through the entire winter (Bent, 1964b).

The species diversity indices for the Douglas-fir type were relatively high during all seasons; the migratory periods exhibited the lowest comparative values (Tables 3-7-246, 3-7-249, and 3-7-251).

3) Upland Meadow (Transect #7) - Fifty-two birds, representing seven species, were recorded in the upland meadow vegetation type during five sampling periods (Tables 3-7-228 and 3-7-229). The horned lark was the most abundant species on an annual basis.

During the two fall sampling periods, three different species were observed in the upland meadow type. Horned larks, white-crowned sparrows, and chestnut-collared longspurs were recorded during October, 1974. A flock of 23 horned larks was observed during October, 1975. Species diversity was zero for this latter census (Table 3-7-251) because this was the only species recorded.

The horned lark was the only species that was consistently at this transect during spring, summer, and fall. During winter qualitative surveys, large flocks of this species were noted within the upland meadow vegetation type, but no individuals were tallied on the February census. This species flocks in large groups during winter months, moving from one feeding area to another. Consequently, it might appear only sporadically within this transect strip through the winter. Of the seven species encountered at this plot, the horned lark is the only species expected to be present from time to time during winter. During early spring, flocks break into pairs for nesting, which begins in the latter part of April (Bailey and Niedrach, 1965; Verbeek, 1967). The horned lark is a characteristic nesting species of Colorado prairies and meadows. It is a ground-nester, utilizing the forbs and grasses characteristic of upland meadow, tundra, and prairie vegetation types (Verbeek, 1967).

The chestnut-collared longspur, a resident of the central grasslands (Bent, 1968), was recorded in the upland meadow type during June, 1975 and in October, 1974. This is a species which was not anticipated to breed in northwestern Colorado. It is a local nester in Weld County, eastern Colorado, and previously had been recorded on only one occasion in western Colorado (Bailey and Niedrach, 1965). The presence of two individuals during June suggests a possible breeding pair.

Although no birds were noted in upland meadow during the winter strip transect surveys (Table 3-7-228), the horned lark, black-billed magpie, and common raven were recorded in this vegetation type during February qualitative surveys. Harsh windswept conditions usually prevail at Piceance Basin upland meadow sites during winter months (Ward, Slauson and Dix, 1974); these conditions undoubtedly contribute to the paucity of birds recorded during fall and winter surveys.

The horned lark was the only species observed in this vegetative type during the spring sampling period, when it was recorded in low numbers (Table 3-7-229).

The species diversity index for the breeding population in the upland meadow type was about average for all the transects (Table 3-7-250). Six species were recorded during June; the horned lark was observed most frequently, but due to differences in detectability, the vesper sparrow, chestnut-collared longspur, and Brewer's sparrow achieved highest breeding densities (Table 3-7-229). The vesper sparrow and Brewer's sparrow are among the most common summer residents in the study area. Brewer's sparrow is distributed throughout the west, especially in sagebrush communities (Bent, 1968). The vesper sparrow has an extensive breeding range in North America. It shows a preference for xeric, sparsely-vegetated sites. It is generally found in dry, upland fields with sparse grass and forb cover, or in fields with widely scattered shrubs or small trees (Wiens, 1969).

Comparisons of the number of breeding species between upland meadow vegetation type and the adjacent Douglas-fir and aspen vegetation types (Tables 3-7-229, 3-7-241, and 3-7-243) demonstrate upland meadows support the fewest breeding species. This situation probably exists because forests have varied understories and multiple strata of foliage not found in grasslands or meadows. The spatial heterogeneity characteristic of woodlands increases species diversity by increasing the number of different resources available (Pianka, 1971).

4) Mixed Brush (Transect #5) - The mixed brush strip transect was surveyed six times during four different seasons, from October, 1974 through October, 1975. Fifty-five birds representing 14 species were recorded over all sampling periods (Tables 3-7-224 and 3-7-225). No one species was observed within this transect during more than one sampling period. Twenty-three individuals, representing six species, were recorded along the northern slope (elevation 7,200 ft) mixed brush transect surveyed during the two fall sampling periods. Mountain chickadees and gray-headed juncos were observed during October, 1974, and scrub jays, robins, mountain bluebirds, and dark-eyed juncos were recorded during October, 1975. The dark-eyed junco is a common winter resident of western Colorado and is

frequently encountered in small flocks of eight to ten, mixed with large numbers of gray-headed juncos (Davis, 1969). It is a seed-eater and winters wherever seeds are plentiful, from the prairie to elevations of 10,000 ft (Bailey and Niedrach, 1965). It utilizes most habitats within the study area and is particularly abundant in the mixed-brush vegetation type. Its breeding range is in Canada (Bent, 1968), and by June few dark-eyed juncos are still in the Piceance Basin.

The mountain bluebird, one of the most common summer residents within the study area, was observed in flocks of 8 to 20 along this transect during the fall. Bluebirds begin forming flocks in early August; the flocks enlarge until migration, which occurs during late September and early October (Power, 1966). Females and juveniles leave the area in early parts of migration; males leave later (Power, 1966). The mountain bluebird has an extensive breeding range which stretches from the Upper Sonoran Zone into the Alpine Zone. It is a cavity nester (Scott and Patton, 1975), and the pinyon-juniper woodland in the study area provides many suitable nesting sites.

Winter species composition varied. During December the black-billed magpie was predominant, but during the February censuses only a single northern shrike was recorded. The black-billed magpie is a resident throughout Colorado, occurring from the eastern grasslands to elevations of 8,000 ft. It nests in all types of woody plants including serviceberry, cottonwoods, junipers, and pinyons (Bailey and Niedrach, 1965). During winter months, magpies are common scavengers in the tract vicinity, and they are frequently observed feeding on dead animals. Its abundance during December 1974 was probably a response to carrion from the hunting season. The northern shrike is a common winter visitor to western slope valleys (Davis, 1969). Microtines appear to be their most frequent prey (Bent, 1965). According to strip transect and qualitative survey data, it is a regular winter resident of valleys in the study area, yet is present only in small numbers. Larger concentrations have been observed outside the study area along Piceance Creek (ECI, 1975a, 1975b).

Low species diversity indices were computed for the winter sampling periods in the mixed brush vegetation type (Tables 3-7-247 and 3-7-248). Only those birds that range over large areas during winter and have scavenging habits, such as the black-billed magpie and raven (Bent, 1964c), were apparently able to utilize this area efficiently during the winter months.

No birds were observed along this transect during the spring census period, but 5 breeding species, the white-throated swift, broad-tailed hummingbird, house wren, blue-gray gnatcatcher, and green-tailed towhee, were recorded in low numbers during June (Table 3-7-225). According to other published information on northwestern Colorado and northeastern Utah (Bailey and Niedrach, 1965; Davis, 1969; Hendee, 1929; Twomey, 1942), these five species do not normally arrive to nest in the region until early May.

5) Mixed Brush (Transect #12) - The strip transect at this location was surveyed five times during four different seasons. The transect was not censused during December, 1974 because of adverse weather conditions. One hundred fifty-six birds, representing 14 species, were recorded on this southern slope (elevation 8,300 ft) mixed brush transect (Tables 3-7-238 and 3-7-239). The gray-headed junco and the mountain bluebird were the most abundant species and were the only species recorded during more than one sampling period.

During the two fall sampling periods, four species were recorded in the southern slope mixed brush type. A large, mixed flock of dark-eyed juncos and gray-headed juncos was observed during October, 1974; a small flock of mountain bluebirds and a few Clark's nutcrackers were recorded during October, 1975. The October, 1975 species diversity index for this transect was considerably lower than the index for northern slope mixed brush (Table 3-7-251). The indices for both transects during October, 1974, however, were equivalent (Table 3-7-246). As indicated earlier, the transient utilization of habitats by fall and winter birds makes comparisons of diversity and abundances of limited value. It is a matter of chance whether the censuses will encounter a mixed flock within a transect during migration or winter. If one is encountered, a high species diversity index will result; if the

transect has few or no birds, the more likely situation, a low diversity will result.

During February, a flock of black rosy finches and brown-capped rosy finches and a separate flock of snow buntings were noted on this transect. The black rosy finch is a common winter visitor on the western slope; it and the brown-capped rosy finch nest above timberline and winter in valleys (Davis, 1969). The only known nesting areas of the brown-capped rosy finch are above timberline in Colorado, southeastern Wyoming, and northern New Mexico (Bailey and Niedrach, 1965). The different rosy finch species often associate with each other during the winter. In northern Utah, the rosy finch flocks arrive on wintering grounds during late October and early November, and depart during the last 2 weeks of March (King and Wales, 1964).

The snow bunting is an uncommon visitor to Colorado's eastern slope and has not previously been recorded in western Colorado (Bailey and Niedrach, 1965; Davis, 1969). The sighting is possibly the first record of the species in northwestern Colorado. The major portion of this species' range is located in the northern United States, Canada, and the arctic islands of North America (Bent, 1968). The snow bunting is a ground-dweller and seldom alights in trees. It is also very gregarious intraspecifically but not interspecifically.

A small group of mountain bluebirds and a flock of 10 gray-headed juncos were the only birds present during April. Twenty-three birds, representing seven species, were recorded during the June sampling period. Approximately 97% of the estimated relative abundance within this transect consisted of Brewer's sparrows, vesper sparrows, green-tailed towhees, and MacGillivray's warblers. All four species are summer residents of western brushland (Bailey and Niedrach, 1965; Davis, 1969). A few Steller's jays and common flickers were also recorded. The Steller's jay is a common resident of conifers in the Transition Zone and probably nests within Douglas-fir stands near the mixed brush transect. The common flicker is found in a variety of habitats throughout the study area and is a common year-round resident on the western slope (Davis, 1969).

Breeding species diversity and population densities were slightly higher for the southern slope mixed brush than for the northern slope mixed brush type (Table 3-7-250). The difference in the structural appearance and micro-environments of both variants of the mixed brush type may contribute somewhat to differences in bird occupancy. The number of strata comprising a vegetative community is normally an important determinant of bird species diversity (Bond, 1957; Hilden, 1965). Although the southern slope mixed brush stand does not support as many plant species as does the northern slope stand, its shrubs are larger and therefore may provide more microhabitats for bird utilization. Considerable microenvironmental variation also exists between the two transects due to differences in slope aspect and elevation. Odum (1959) reported variations in species composition and distribution due to microenvironmental differences between north slope and south slope variants of a single vegetation type.

6) Pinyon-Juniper (Transect #10) - From October, 1974 through October, 1975 the pinyon-juniper strip transect was surveyed six times during four different seasons. Eighty-two birds representing 22 species were observed within this stand (northern slope/6,900 ft), as summarized in Tables 3-7-234 and 3-7-235. The mountain chickadee was the most abundant year-round species, and the chipping sparrow was the most common breeding species.

Three species, the black-billed magpie, mountain chickadee, and ruby-crowned kinglet, were present in small numbers during October 1974. A greater number of species was present during October 1975, when the dark-eyed junco dominated relative abundance. Four species were recorded on winter censuses. The December sample included only five scrub jays, while the February sampling period disclosed a more diverse, denser avian community. During February, a large mixed flock of mountain chickadees, plain titmice, and red-breasted nuthatches comprised 98% of the total relative abundance. Two scrub jays were also observed at this time.

Scrub jays are common residents of areas containing Gambel oak (Davis, 1969). As indicated by strip transect and qualitative survey data, the scrub jay commonly occurs in mixed brush and pinyon-juniper stands on and near Tract C-a. It utilizes the pinyons, junipers, and oaks as sites for building its large nests. The plain titmouse is common in southern and western Colorado pinyon-juniper woodlands (Bailey and Niedrach, 1965). It is a cavity nester, preferring pinyons, junipers and Gambel oaks. The red-breasted nuthatch is the least common of the three nuthatch species in Colorado. Davis (1969) reported that it is a rare resident in western Colorado, where it nests in transition forests and winters at lower altitudes. This species has been recorded as a summer and winter resident within the Douglas-fir type and as a winter resident in the north slope pinyon-juniper type on the study area.

The spring sampling period failed to reveal any bird activity. Harsh weather conditions experienced throughout the April period of censusing may partially explain low bird numbers in areas where higher densities were expected.

Thirteen species were recorded on the June strip transect census. The chipping sparrow, mountain chickadee, and black-throated gray warbler accounted for 77% of the total estimated population density for this stand. The chipping sparrow is one of the most common sparrows in the 6,000 to 8,000 foot elevational zones in Colorado, where it nests in shrubs and small trees (Bailey and Niedrach, 1965). Northern slope pinyon-juniper woodlands which support a dense shrub understory provide ideal nesting habitat for the chipping sparrow. The mountain chickadee and black-throated gray warbler both nest in coniferous forests (Bailey and Niedrach, 1965; Bent, 1963a). The mountain chickadee is a common species in the pinyon-juniper woodland throughout the year, while the black-throated gray warbler is generally a common summer resident (Davis, 1969). The grasshopper sparrow observed and heard singing during June must be considered highly unusual in this habitat.

7) Pinyon-Juniper (Transect #9) - Fifteen species were tallied in the southern slope pinyon-juniper transect (7,000 ft) in six censuses from October, 1974 through October, 1975 (Tables 3-7-232 and 3-7-233).

Twelve species were present during the breeding season, but few individuals or species were observed utilizing this woodland during other periods of the year. The scrub jay was encountered in more seasons than any other species, but was never present in abundance.

During the two fall sampling periods, three species were recorded. A scrub jay and a mountain chickadee were observed during October, 1974, and mountain bluebirds and scrub jays were in this pinyon-juniper woodland the following fall. The species diversity index for October, 1975 was low in comparison with other transects surveyed, but was higher in October, 1974 (Tables 3-7-246 and 3-6-251). No birds were tallied during either winter census.

During April, a flock of pinyon jays contributed 87% of relative abundance at this transect. Only two other species were observed. The pinyon jay is a common resident of the pinyon-juniper woodland (Bailey and Niedrach, 1965; Davis, 1969); unlike other jays, pinyon jays often occur in large flocks. They build their nests in pinyon pines and junipers. They occur irregularly and often are present in large numbers one season but absent the next (Bailey and Niedrach, 1965). No pinyon jays nested in either of the censused pinyon-juniper communities during 1975.

The sparse, mature stand of pinyon-juniper on Transect #9 supported a relatively diverse avian population during June, in contrast to the poor diversity recorded for this vegetation type during other seasons (Tables 3-7-246 through 3-7-251). Twelve species inhabited this pinyon-juniper stand during summer. The most abundant nesting species were the bushtit and mountain bluebird. The bushtit inhabits the pinyon-juniper woodland of western Colorado. It is found in rugged, dry canyons where it nests in pinyons, aspen, tall sagebrush, mountain mahogany, and cottonwood-willow river bottoms (Bailey and Niedrach, 1965). The other species attaining greatest relative abundance are all characteristic nesting species of pinyon-juniper habitat.

Although little variation occurred between the number of species supported by the two pinyon-juniper transects (#9 and #10) throughout the year, the species found within each transect were not similar. Only five of the 12 breeding species in the southern slope stand (#9) occurred in northern slope pinyon-juniper (#10). This variation in species composition between the two stands may be partially attributable to the denser understory present in the northern slope stand. The north slope pinyon-juniper vegetation type provides more suitable habitat for those species associated with a woodland understory (e.g., green-tailed towhee, Brewer's sparrow, and chipping sparrow). The south slope pinyon-juniper vegetation type is located near small cliffs and a stream, both prime nesting sites for the flocks of white-throated swifts, rough-winged swallows, cliff swallows, and tree swallows that aerially feed on the transect's local insect population.

8) Pinyon-Juniper/Sagebrush (Transect #6) - One hundred forty-one birds representing 18 species were recorded for the pinyon-juniper/sagebrush transect (Tables 3-7-226 and 3-7-227) in six censuses from October, 1974 through October, 1975. No species was particularly abundant throughout the year; the mountain bluebird was the only species recorded during three or more sampling periods. Except for three mountain chickadees tallied during December, no wintering birds were observed.

Nine species were present in the pinyon-juniper/sagebrush type during two October censuses. A large flock of 70 horned larks was recorded during October, 1974, along with a small flock of mountain bluebirds, one scrub jay, and one mountain chickadee. This preponderance of horned larks produced a low diversity index (Table 3-7-246). By contrast, seven species having a relatively high equitability were present in October 1975, resulting in a high species diversity index (Table 3-7-251). In October, 1975, the bushtit, rufous-sided towhee, and sage sparrow comprised 91% of the total relative abundance. The bushtit, an extremely gregarious bird which often congregates in groups of 40 to 50 individuals (Bent, 1964c), was observed flocking in the pinyon pines and junipers. The rufous-sided towhees and sage sparrows were observed in the sagebrush understory.

The rufous-sided towhee is an uncommon resident of brush and Gambel oak on the Western Slope and during the winter is generally confined to valleys. It is less common in western Colorado than would be expected in view of its abundance in oak in eastern Colorado (Davis, 1969). This towhee is a ground-nester and generally doesn't nest until mid-June (Bailey and Niedrach, 1965). The rufous-sided towhee has not been recorded in the study area during the winter, but has been observed in small numbers in mixed brush communities throughout the remainder of the year.

The sage sparrow is a common but secretive species of the sagebrush type in northwestern Colorado and northeastern Utah (Twomey, 1942; Davis, 1969). Sage sparrows are ground-dwellers and feed primarily on insects. The sparrows congregate in loose flocks during late summer and fall, and most individuals migrate south in late September and October (Bent, 1968). This sparrow has been recorded in sagebrush and mixed brush types only during the fall; due to its secretive behavior, it is difficult to detect unless it is engaging in flocking, so the possibility of individuals nesting within this sampling area nonetheless exists.

The mountain chickadee was the only species observed in this transect during the winter sampling periods. Three individuals were recorded during December and none was seen during February. No birds were recorded on transect #6 during the spring census.

The stand of mixed pinyon-juniper and sagebrush supported a variety of breeding birds indicative of woodland and/or brushland communities in northwestern Colorado (Davis, 1969). Species such as the Brewer's sparrow, blue-gray gnatcatcher, and green-tailed towhee are typically associated with brush communities (Bent, 1964a, 1968); all three were common in the pinyon-juniper/sagebrush type during June. The pinyon pines and junipers of the area attracted feeding tree swallows and cliff swallows, and nesting mountain bluebirds. The other common summer resident, the lark sparrow, was associated with open patches of grasses and forbs within this vegetation type. The blue-gray

gnatcatcher is a common summer resident of western Colorado's sage, pinyon-juniper, and mixed brush (Davis, 1969). According to Root (1967), blue-gray gnatcatchers shift their habitat preference in accordance with the seasonal changes of optimal food resources. The gnatcatcher is a foliage-gleaner, obtaining its insect diet primarily from shrubs.

The tree swallow is a common summer resident throughout Colorado (Bailey and Niedrach, 1965). During migration, this species often lingers in the Colorado plains until May, when it ascends into the mountains to nest sites in pine, spruce, and aspen. It is a cavity nester (Scott and Patton, 1975) and probably utilizes pinyon pines and junipers as nest sites, for it was observed rather commonly near or in the pinyon-juniper woodland type throughout the summer. It will nest in isolated pairs as well as semi-colonially (Graber, Graber, and Kirk, 1972). The cliff swallow is also a common summer resident in western Colorado, nesting on cliffs, buildings, and bridges (Davis, 1969). It is a common summer resident along the drainages in the study area, probably nesting in the many rock outcroppings associated with drainages. The cliff swallows observed within this transect were feeding on the local insect populations, but were probably not nesting due to a lack of suitable nest sites within the transect. However, small cliff faces are located 0.8 km (0.5 mi) south of the transect along the right fork of Stake Springs Draw. This area could support a nesting population of cliff swallows.

Lark sparrows are common summer residents in dry brushy areas in western Colorado (Davis, 1969). They nest on the ground and prefer areas in or adjacent to bare ground and short grass (Bent, 1968).

The June species diversity index for this transect was high in comparison with other transects. The pinyon-juniper/sagebrush transect is an ecotone (a place where two distinct communities intergrade); ecotones tend to contain a relatively large number of species because they often contain many of the organisms of each of the overlapping communities in addition to those organisms which are characteristic of and often restricted to the ecotone (Odum, 1971).

9) <u>Pinyon-Juniper/Mixed Brush (Transect #4)</u> - Thirty-one birds of 11 species were recorded within the pinyon-juniper/mixed brush transect (northern slope, 7,400 ft elevation) during six censuses (Tables 3-7-222 and 3-7-223). The black-billed magpie was the only species observed during more than two seasons. During winter and spring, no birds were present along this strip transect.

During the two fall sampling periods, seven species were recorded. The black-billed magpie and dark-eyed junco were observed during both fall censuses. Five other species were also recorded during October, 1975, when the mountain chickadee and dark-eyed junco were the most common.

Seven species (19 individuals) were observed along this transect during June. All were species typically associated with pinyon-juniper woodland and mixed brush communities in northwestern Colorado and northeastern Utah (Davis, 1969; Twomey, 1942). No one species numerically dominated the avian community during summer; mountain bluebirds, green-tailed towhees, and Brewer's sparrows were the most frequently observed species.

The green-tailed towhee is a common summer resident of western Colorado. It prefers Gambel's oak and serviceberry stands and is a rare winter resident in the valleys of western Colorado (Davis, 1969). It is found in all types of brushland within the study area during the breeding season and is one of the study area's most abundant summer residents.

The species diversity index for the June census conducted in the pinyon-juniper/mixed brush transect was considerably lower than the species diversity index for the June census conducted within the pinyon-juniper/sagebrush transect (Table 3-7-250). The species diversity indices computed for the other surveys conducted within these two transects either demonstrate slightly higher values for the pinyon-juniper/mixed brush transect or equal values for both transects (Tables 3-7-246 and 3-7-251).

10) <u>Sagebrush (Transect #2)</u> - During six surveys from October, 1974 through October, 1975, 27 birds of seven species were recorded in this big sagebrush stand at elevation 6,500 ft (Tables 3-7-218 and 3-7-219). More

species were present during the summer than during migration periods, and no birds were tallied on two winter censuses. The community had the lowest cumulative breeding bird density of the 15 vegetation types censused for birds.

Three species were recorded during the two fall sampling periods. The sage sparrow was recorded during both censuses, while the horned lark and mountain bluebird were noted only during the October, 1975 survey.

During summer, low numbers of lark sparrows, Brewer's sparrows, vesper sparrows, and lark buntings were recorded. This is the only location where lark buntings were observed during the first year of field censuses. This is a species which nests throughout Colorado in the Upper Sonoran zone. It is particularly abundant on the state's eastern grasslands. According to Bailey and Niedrach (1965), it was reported as a common species in Moffat County during 1957. Lark buntings appear to change nesting areas periodically; consequently, the uncommon status of the species within Tract C-a and adjacent areas could change over·time.

11) Sagebrush (Transect #11) - Sixty birds of 12 species were recorded during five censuses of the big sagebrush vegetation type (Tables 3-7-236 and 3-7-237). This transect traversed a north-facing slope at 7,100 ft elevation. The transect was not sampled during December, 1974 because of adverse weather conditions. No species were observed during the October, 1974 census, but eight species were tallied during October, 1975. The yellow-rumped warbler, mountain bluebird, and vesper sparrow comprised 5% of the fall population estimated total relative abundance.

The yellow-rumped warbler is a common summer resident and uncommon winter resident in mountain forests of the western slope (Davis, 1969). It begins nesting by mid-June at elevations between 8,000 and 11,000 ft. Flocks of adult and immature birds commonly appear in mountain valleys and basins during the fall. The yellow-rumped warbler is one of the most common and conspicuous birds on Tract C-a during the fall, when it is often seen in small flocks of 8 to 10 in a variety of habitats.

According to data, the north slope sagebrush transect (#11) supported a denser and more diverse breeding population than that supported by the sagebrush community at Transect #2 (Tables 3-7-250, 3-7-237, and 3-7-219). This is partially explained by the denser sagebrush cover and the more diverse herbaceous layer which was evident at Transect #11. A more diverse plant community should generally supply more available microhabitats, thereby promoting a greater diversity of bird species.

12) Greasewood/Sagebrush (Transect #8) - The strip transect which censused the greasewood/sagebrush (flat 6,400 ft) vegetation type was surveyed six times during four seasons, between October, 1974 and October, 1975. One-hundred thirty-one birds of 21 species were recorded (Tables 3-7-238 and 3-7-239). No species was consistently abundant throughout the year, and virtually no birds inhabited the transect area during winter. During the two fall sampling periods, 12 species were observed. Yellow-rumped warblers, song sparrows, and white-crowned sparrows were the only birds recorded during October, 1974, but 10 species were observed on the October, 1975 census. The mountain bluebird, Brewer's sparrow, and vesper sparrow were the most abundant species in fall 1975, cumulatively attaining 72% RA.

The only species recorded during the winter sampling periods was a single scrub jay observed during December. Species diversity increased during the April sampling period when four species were recorded, including a large flock of 22 dark-eyed juncos and 22 gray-headed juncos. The spring flocks of juncos were probably preparing to migrate to the species' summer residence in the montane forests of Colorado, northwestern United States, and Canada (Bailey and Niedrach, 1965; Davis, 1969).

Of the 12 species recorded in this greasewood/sagebrush stand during June, the Brewer's sparrow and chipping sparrow together accounted for 65% of the relative abundance. This stand supported the largest population of Brewer's sparrows of any strip transect surveyed during June. Brewer's sparrow is one of the most common breeding birds on and close to Tract C-a.

The chipping sparrow is a common summer resident of Colorado's western slope in open areas interspersed with trees, particularly in the pinyon-juniper vegetation type (Davis, 1969). The first chipping sparrows generally arrive in flocks in the Upper Sonoran Zone of Colorado in late March, just about the time the tree sparrows depart for the north. During the April sampling period, chipping sparrows have been observed within the study area during qualitative surveys conducted in the mixed brush vegetation type in Corral Gulch. They have also been recorded as a common summer resident of the pinyon-juniper woodland vegetation type during qualitative surveys.

None of the species observed during June, with the exception of the scrub jay, was recorded on this transect during the winter or spring censuses, nor were any gray-headed or dark-eyed juncos, birds characteristic of this vegetation type in the winter, recorded during the June survey. This and examples from most other transects illustrate a seasonal theme which characterizes avian community dynamics in this part of the nation -- that of a high seasonal turnover of species utilizing habitats during summer and winter. A high percentage of breeding species in the Piceance Basin migrate to more southern areas for the winter.

13) Rabbitbrush (Transect #3) - One hundred thirty-five birds of 17 species were recorded on six censuses at transect #3 (Table 3-7-220 and 3-7-221). The mountain bluebird was observed during more sampling periods than other species (October, 1974, April, 1975, June, 1975, and October, 1975). Winter and spring censuses recorded low densities.

Ten species were recorded during the two fall sampling periods. The species diversity index for this transect was the second highest of all transects for the October, 1975 sampling period, and highest of all transects for October, 1974 (Tables 3-7-246 and 3-7-251). Eight species were recorded during October, 1975, when the white-crowned sparrow and mountain chickadee comprised 63.3% of the total relative abundance for this sampling period. Five species were recorded during October, 1974. The mountain bluebird, gray-headed junco, and white-crowned sparrow accounted for 77% of the total relative abundance during this sampling period.

No birds were recorded during the December sampling period but 29 birds representing 3 species were recorded during February. A flock of 25 bushtits accounted for 88% RA for this sampling period. The bushtit is a fairly common resident of the brush and pinyon-juniper vegetation types in the study area. Only two species, the mountain bluebird and rufous-sided towhee, were recorded during the April census. Both were present in relatively small numbers.

Six species were recorded during June, when the Brewer's sparrow and green-tailed towhee together comprised 84% RA. A small flock of seven cliff swallows and one rough-winged swallow was also observed traversing the transect, feeding on flying insects.

14) Riparian (Transect #15) - The strip transect which traversed riparian habitat was surveyed five times during four seasons. This transect was not sampled during the December census period due to adverse weather conditions. Twenty-seven species were recorded during the five sampling periods (Tables 3-7-244 and 3-7-245). The red-winged blackbird, yellow-rumped warbler, and mountain bluebird were the most abundant species recorded on an annual basis. No birds were seen at this location during the February census.

Ten species were recorded during two autumn censuses. Seven species were observed during October, 1974, with the yellow-rumped warbler, mountain bluebird, and mountain chickadee most abundant (90% RA). During October, 1975, six species were recorded and the yellow-rumped warbler and the white-crowned sparrow comprised 93% of relative abundance. The species diversity index did not vary significantly from the October, 1974 sampling period (Tables 3-7-246 and 3-7-251).

A substantial increase in bird numbers occurred between the February and April censuses. Thirteen species were recorded during April in the riparian transect, whereas no birds were tallied during the winter census. The most abundant species during April were gray-headed juncos, dark-eyed juncos, mountain bluebirds, and red-winged blackbirds. This transect attained the

highest species diversity for all transects during the April sampling period (Tables 3-7-249).

The variety of birds occupying the riparian transect during the June census period is indicative of the heterogeneity of habitat along this portion of Stakes Spring Draw. Many species that were present are usually associated with western riparian or brushland habitat types (Twomey, 1942; Bailey and Niedrach, 1965; and Davis, 1969). During the June survey, 14 species were noted. The total population was numerically dominated by song sparrows, red-winged blackbirds, and Brewer's sparrows.

The song sparrow is a common summer resident in brush and thickets near water, and less common in these habitat types during the winter (Bailey and Niedrach, 1965; Davis, 1969). It seems to prefer areas with mild winter weather (Tompa, 1962). The harsh winter conditions generally prevalent throughout the Piceance Basin undoubtedly limit the area's wintering song sparrow population. Only two sparrows have been recorded during the winter within the study area; these were observed in Ryan Gulch during a qualitative survey.

The red-winged blackbird is a common western slope resident, nesting in marshes and wintering in large flocks in the moutain valleys (Bailey and Niedrach, 1965; Davis, 1969). This blackbird is graminivorous most of the year, but becomes insectivorous while breeding (Willson and Orians, 1963). The red-winged blackbird is a common summer resident along the creeks in the study area, but has not been recorded during the winter. The density of red-winged blackhirds tripled between April and June, 1975. Male red-winged blackbirds migrate during March and early April and establish territories before females arrive. During the April census, males were present but few females had appeared. The species is polygynous, and one male can form simultaneous pair bonds with four or five females.

The priarian type supported the second largest number of species of all transects during June; nonetheless, the species diversity index (Table 3-7-250) was not one of the largest because of the preponderance of only three breeding species. In addition to species listed in Tables 3-7-242 and 3-7-243, four species of waterbirds were also noted on strip censuses of this habitat.

15) Bottomland Meadow (Transect #1) - The bottomland meadow (flat/6,300 ft) strip transect was surveyed six times during four seasons. Twenty-three species were recorded for the entire year (Tables 3-7-216 and 3-7-217). No species was particularly abundant throughout the year. During the two fall censuses, seven species were recorded, three species during 1974 and four during 1975. Horned larks comprised 82% of the relative abundance during the October, 1974 census. A water pipit and black-billed magpie were also recorded. Western meadowlarks, red-winged blackbirds, and mountain bluebirds numerically dominated the estimated avian population (97% RA) during October, 1975.

Four species were recorded in low numbers during the winter. Two species, the black-billed mapgie and common raven, were observed on both winter censuses. The horned lark and tree sparrow were also recorded during February. These species are all winter residents of the meadows and brushland within the study area. Five species were present during April including a single western wood pewee. The western wood pewee is normally a common summer resident of western deciduous and coniferous forests (Davis, 1969), but it is known to nest in Colorado from the prairies to elevations of 10,000 ft (Bailey and Niedrach, 1965). The presence of this species during April and the absence of sightings during the breeding season suggests the bird was a migrant which stopped to feed in the riparian vegetation before proceeding on to forested country to nest. The western wood pewee was sighted within the pinyon-juniper/sagebrush vegetation type during June. The pinyon pines and junipers are likely nesting sites for this pewee, as are the aspen and Douglas-fir vegetation types within the study area.

The influx of species to the bottomland meadow transect between April and June sampling periods was substantial, and 19 species were observed during June. The estimated population densities of most species were small. All were in the range of 0.1 to 0.9 birds/ha. All species encountered during June can be expected to inhabit meadows, pastures, and riparian vegetation types on Colorado's western slope (Bailey and Niedrach, 1965; Davis, 1969). During June, this habitat achieved a higher maximum diversity than any other transect attained in any season (Tables 3-7-246 through 3-7-251.

b. Upland Gamebirds

1) Sage Grouse - Opportunistic sightings of sage grouse were recorded during all field activities. Aerial surveys were conducted in April to locate sage grouse strutting grounds (leks) in the tract vicinity. The first survey was conducted on April 25 over 84 Mesa; the second covered an area west of Tract C-a. Results of two brood censuses conducted in the vicinity to investigate sage grouse nesting success have shown both areas to be inhabited by sage grouse. These were conducted July 14-15, 1975 along a 32 km (20 mi) route located in sagebrush and mixed brush vegetation types, the preferred nesting habitats for sage grouse (Patterson, 1952; Rogers, 1964).

During fall and winter field activities, 24 sage grouse were observed in sagebrush habitat on the eastern slopes of Cathedral Bluffs. Opportunistic sightings during fall, 1975 provided records of sage grouse in two other locations. Two sightings, the first of four and the other of one grouse (all adults), were recorded on the ridge northwest of the right fork of Stake Springs Draw within a sagebrush/mixed brush vegetation type. Four sage grouse (all adults) were reported on Cathedral Bluffs within a mountain shrub community.

The two aerial surveys revealed the presence of two strutting grounds west of Tract C-a. The first lek was occupied by 27 sage grouse (20 males, seven females) and the other was occupied by six sage grouse (four males, two

females). Both leks were in open areas surrounded by sparse sagebrush cover. Sage grouse strutting grounds were not observed on 84 Mesa (Figure 3-7-66). Mr. Ronald J. Krager, Wildlife Conservation Officer for the Colorado Divison of Wildlife, was consulted to obtain information on sage grouse utilization of 84 Mesa. Mr. Krager noted that, prior to the placement of a water pipeline across 84 Mesa by the Bureau of Land Management, grouse utilized an area in Section 19, T1S, R98W for strutting (Figure 3-7-66). However, over the last few years, the number of sage grouse using the lek has steadily decreased (Krager, personal communication, 1975). Sage grouse have not been observed displaying in the area during recent surveys.

During the early spring survey period, four sage grouse were observed in sagebrush habitat on the eastern slopes of Cathedral Bluffs. Three sage grouse were flushed from sagebrush habitat on 84 Mesa. None of these sage grouse was on a lek. Four sage grouse (one female, three chicks) were observed during the July 14, 1975 breeding census, and two flocks comprised of seven (two males, one female, four chicks) and 17 (three female, 13 chicks) birds, respectively, were seen during the July 15 census. All sightings were within a 1.6 km (1 mi) segment of the census route on the ridge of the right fork of Stake Springs Draw, within an upland sagebrush vegetation type. Two opportunistic sightings in this vicinity on July 30-31, 1975 involved 27 sage grouse.

Summer observations of sage grouse populations in two other locations within the study area included 13 (11 adults, two juveniles) on Cathedral Bluffs within a mountain shrub vegetation type, and two sightings of five and three sage grouse (adults and young, respectively) on Airplane Ridge within a sagebrush/mixed brush vegetation type. The repeated sightings of juveniles with adults indicate that sage grouse are nesting near each of the locations indicated above.

Rogers (1964) described sage grouse density in the region as "light" and indicated that sage grouse have only been observed in low numbers within sagebrush communities in the Piceance, Yellow and Douglas Creek drainages.

Rogers (1964) has recorded them on 84 Mesa, the only area in Rio Blanco County near Tract C-a where they have also been sighted by ECI personnel. A possible explanation for the reported scarcity of sage grouse in Rio Blanco County, according to Rogers (1964), is that a large amount of the sagebrush range in the basin is intermixed with pinyon-juniper, a combination apparently avoided by this grouse. Rogers (1964) also stated that sagebrush in Rio Blanco County occurs in steep, narrow canyons with little available water, habitats not preferred by sage grouse.

Sage grouse are apparently not limited to the sagebrush vegetation type in the study area; rather, they inhabit a variety of upland brush vegetation types on and near Tract C-a. All observations within the tract vicinity indicate a moderate population of sage grouse within the areas of upland sage and mixed brush vegetaion types in southwest portions of the study area, and a small population on 84 Mesa (Figure 3-7-66). There appears to be little seasonal migration of this population, although this is difficult to gauge because most sage grouse observations are from the spring and summer periods, and few sightings have occurred in winter.

2) Blue Grouse - Records of opportunistic sightings of blue grouse have been maintained throughout the first year. Blue grouse were also censused twice along a standard census route on June 11 and 12 during the blue grouse display season (Rogers, 1968) by procedures outlined earlier.

During fall 1974 and winter 1974-75, only five blue grouse were seen on Cathedral Bluffs, the area expected to support the greatest population of this gamebird. However, blue grouse were observed rather frequently, either opportunistically or during conduct of strip transects, during fall, 1975. The eight encounters, all within a 5 km (3 mi) section of Cathedral Bluffs, included 38 blue grouse. Seven of the eight encounters occurred within, or adjacent to, the Douglas-fir and aspen strip transects. During the September 30 - October 5, 1975 small mammal trapping period, 26 blue grouse were observed within the Douglas-fir grid and in an aspen stand adjacent to this grid. Four blue grouse were also seen within the Douglas-fir grid during the October, 1975 strip transect. One blue grouse was

recorded within the aspen transect during the fall census. The only record of blue grouse outside of an aspen or Douglas-fir stand during fall 1975 was a sighting of seven blue grouse within an upland meadow vegetation type located a few kilometers south of the Douglas-fir small mammal grid.

The Cathedral Bluffs area appears to support a fairly large population of blue grouse. During the road survey conducted June 11-12, 1975, 23 displaying male blue grouse were tallied. This amounts to 2.4 grouse/km (1.5/mi) of road. This compares to 0.14 grouse/km for the best 2.4 km section of road surveyed by Rogers (1968) in Colorado over a 3-year period. The many opportunistic sightings of blue grouse recorded during 1974 and 1975 (66 birds recorded to date) also suggest that a relatively large population inhabits the Cathedral Bluffs area (Figure 3-7-66). This blue grouse population is found year-round on Cathedral Bluffs, but localized seasonal movements apparently occur. During the breeding season, most individuals inhabit the meadow, mixed brush, and aspen/mixed brush ecotone areas. After breeding and resting, the birds appear to move to dense stands of Douglas-fir and aspen. However, not all the blue grouse migrate to heavily timbered areas; some individuals were still observed during the fall and winter in meadow and mixed-brush vegetation types. The absence of blue grouse in these habitats during the August survey and the large number of grouse observed on the Douglas-fir and aspen small mammal grids during the fall (compared to their absence in these grids during the breeding season) suggest that a portion of the population does migrate. According to Rogers (1968), the timing and extent of these movements are related to food availability and weather conditions.

3) Mourning Doves - Most mourning doves had left the study area by October, as evidenced by the lack of mourning dove observations on strip transect and qualitative censuses in October, 1974 and very few observations in fall, 1975. The few individuals observed during October, 1975 were recorded in riparian and lowland mixed brush vegetation types. Mourning doves had returned to the Piceance Basin by early April and were first observed in the Tract C-a at 84 Ranch on April 29.

The possibility of an earlier migration into the Piceance Basin cannot be ruled out, since no bird censuses were made during March and early April. Mourning dove fall migrations generally begin at the end of August; usually only scattered individuals are observed in breeding locales after mid-September. By the June census periods, the mourning dove appeared to be a common summer resident in the pinyon-juniper and greasewood/sagebrush vegetation types. During the June surveys, 17 sightings of mourning doves were recorded in the pinyon-juniper vegetation type, and three in the greasewood/sagebrush vegetation type.

The mourning dove is the most widely distributed game bird in the Tract C-a vicinity. During general field activities coinciding in time with the breeding season, this dove was observed in many habitats, with the greatest number of observations in pinyon-juniper and greasewood/sagebrush vegetation types. The preferred nesting sites of this species are usually close to water and trees, so actual breeding habitat tends to be more restricted than the range of vegetation types the mourning dove is capable of exploiting if water is well distributed. Trees are favored sites for roosting, daytime resting, and nesting (Davis and Anderson, 1973). The habitats in the study area most frequented by the mourning dove are thus in or adjacent to woodlands.

Mourning doves are not communal nesters, but they pursue gregarious habits soon after the breeding season terminates. From late July until fall migration, doves congregate in roosting places (Bent, 1963b). The pinyon-juniper woodland vegetation type in the study area provides many of these communal roosting sites for the mourning dove.

c. Waterfowl and Shorebirds - The Stake Springs Draw impoundment received light usage by waterbirds during fall 1974 and 1975 migration periods. During October, 1974, only the mallard was observed at the impoundment, and only 15 individuals of four species (mallard, green-winged teal, blue-winged teal, killdeer) were seen at the impoundment during counts made between October 6 and 13, 1975. During other field activities in September and October, 1975, 23 blue-winged teal, one killdeer, one common snipe, and nine mallards were observed in riparian habitat types within

the study area. The Piceance Basin is not recognized as a segment of any major migratory route within the Pacific waterfowl flyway, the major flyway west of the Continental Divide (Dr. Ronald A. Ryder, personal communication, 1975). This, plus the paucity of water in the Tract C-a vicinity, accounts for the scarcity of waterfowl observed during fall migration.

During spring, when more water is available, increased waterfowl utilization of the area occurs. In April 1975, ducks were present in Stake Springs Draw, Ryan Gulch, and Black Sulfur Gulch. Mallards and green-winged teal, totalling 50 birds, were recorded at the Stake Springs impoundment during counts on April 15 and 17. During other April field activities, mallards were observed in Ryan Gulch and Black Sulfur Gulch, and 54 birds consisting of mallards, green-winged teal, and blue-winged teal were seen at the Stake Springs Draw impoundment.

A total of five ducks and eight shorebird species was observed during the two summer sampling periods. In June, 11 species were recorded at the Stake Springs Draw impoundment. The mallard, green-winged teal, and common snipe were the most abundant. Wilson's phalarope, killdeer, spotted sandpiper, gadwall, cinnamon teal, sora, Virginia rail and blue-winged teal were also present, but in lower numbers. The semi-palmated plover, long-billed curlew and white-faced ibis were also recorded during general avian surveys in June. Waterbird abundances were relatively high during the August census period when a total of 62 birds was recorded. However, only four species, the mallard, killdeer, American avocet, and solitary sandpiper were present on the impoundment. The mallard was the most abundant species recorded during the August survey, and was observed during every count. On one morning, 35 mallards were observed feeding in the pond. The large numbers of mallards present during mid-August may be due to pre-migration flocking. Although the migration flights do not begin in earnest until late September, flights from local nesting areas to nearby feeding grounds occur in late August or early September (Kortright, 1967). Perhaps many of the mallards that nest in the Tract C-a vicinity congregate and feed in the Stake Springs pond before migrating south.

Results from the year's surveys indicated that usage of the area by ducks and shorebirds is greater during late spring and summer than during fall, but that waterbird populations within the general area are very low. Considerably more ducks were observed along Piceance Creek and its associated ponds (ECI, 1974; 1975a; 1975b; 1975c) than were seen within the Tract C-a study area. The scarcity of open water within the study area is undoubtedly the major limiting factor on the size of the resident and migratory waterfowl population.

In summary, the mallard, green-winged teal, blue-winged teal, killdeer, and common snipe are the most common waterfowl and shorebird species found within the study area. The Stake Springs impoundment and the riparian habitats within the study area support a small breeding and migrating population of these species.

d. Raptors

1) Aerial Surveys - Raptor aerial surveys were initiated during November, 1974 and were continued bimonthly until August, 1975. Raptor aerial surveys were not conducted during October, 1975 due to inclement weather and big game hunting seasons. Table 3-7-252 summarizes raptor data resulting from aerial surveys. Relative abundance for each sampling period and the entire year are also presented. However, the few small raptors recorded during aerial surveys are not a fair indication of the relative abundance of these birds on the study area, since small, low-flying raptors such as accipiters and falcons are difficult to detect from an aircraft.

The common raven was the most abundant raptor species, attaining 58% RA through the year. This species was encountered on every raptor survey. The golden eagle and rough-legged hawk were observed less frequently, but were the only other species with a relatively high RA percentage. The golden eagle was recorded during every survey except the one conducted during June.

Table 3-7-252. Raptor species encountered during aerial surveys, fall, 1974 through fall, 1975 for RBOSP

Species	11/74* Totals	% R.A.**	12/74 Totals	% R.A.	1/75 Totals	% R.A.	2/75 Totals	% R.A.	3/75 Totals	% R.A.	4/75 Totals	% R.A.	6/75 Totals	% R.A.	8/75 Totals	% R.A.	Total by Species	Total % R.A. ***
Northern Bald Eagle	0	0.0	0	0.0	0	0.0	1	4.0	0	0.0	0	0.0	0	0.0	0	0.0	1	.7
Golden Eagle																		
Mature	5	41.7	3	33.3	2	7.7	3	12.0	3	13.0	2	18.1	0	0.0	0	0.0	18	14.4
Immature	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	11.1	1	.8
Marsh Hawk	1	8.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	.8
Cooper's Hawk	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	9.1	0	0.0	1	11.1	2	1.6
Red-tailed Hawk	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	9.1	3	30.0	1	11.1	5	4.0
Rough-legged Hawk	2	16.7	3	33.3	7	26.9	6	24.0	0	0.0	0	0.0	0	0.0	0	0.0	18	14.4
Peregrine Falcon	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	9.1	0	0.0	0	0.0	1	.8
American Kestrel	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	10.0	3	33.3	4	3.2
Common Raven	4	33.3	3	33.3	17	65.4	15	60.0	20	87.0	6	54.5	6	60.0	1	11.1	51	57.6
Unidentified Raptor	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	22.2	2	1.6
TOTAL	12	100.0	9	100.0	26	100.0	25	100.0	23	100.0	11	100.0	10	100.0	9	100.0	125	100.0

* Date

** Relative abundance = $\frac{\text{Total number of species A}}{\text{Total number of all species observed}}$.

*** Percent relative abundance for the entire year.

The rough-legged hawk is a winter resident in the Piceance Basin and was commonly observed between November, 1974 and February, 1975. The northern bald eagle was recorded once during February. The marsh hawk, Cooper's hawk, and American kestrel were observed in small numbers, but these species are not easily censused by airplane due to their small size and/or low flying habits. The marsh hawk was observed once during November and April; the Cooper's hawk was observed once during the spring and once during the summer, while the American kestrel was observed once in June and three times in August (Table 3-7-252).

The red-tailed hawk was not recorded frequently during the aerial surveys but was commonly recorded during ground investigations. One peregrine falcon was also observed during an April flight. The status of all the raptor species observed in the Tract C-a study area is discussed later in detail.

The distribution of raptor sightings demonstrate certain interesting trends (Figure 3-7-67). Most raptors were recorded within the eastern half of the study area and along the drainages. The raven was most frequently observed along Yellow Creek and 84 Mesa during the winter and spring. The majority of golden eagles was observed during the winter along Cathedral Bluffs. All rough-legged hawks, with the exception of one observed on Cathedral Bluffs, were recorded east of Tract C-a. The other raptor species have been observed too infrequently to speculate on distributional tendencies.

2) Ground Surveys - Raptors noted during all avian field activities conducted between October, 1974 and October, 1975 were recorded by species and location of observation. In the course of field investigations, all raptor nests encountered were examined and their location plotted on field maps. During late April and early June, potential raptor nesting habitats on Tract C-a and the surrounding area were traversed on the ground for four consecutive days to locate active nests. Results are given in Table 3-7-253.

Night owl surveys were initiated in December, 1974 and were repeated during April, 1975. Surveys were conducted on two nights during the two sampling periods.

Table 3-7-253. Active raptor nests located on or near Tract C-a during April, 1975 for RBOSP[1/]

Nest Number	Species	Contents of Nest	
		Eggs	Chicks
1	Red-tailed hawk	3	0
2	Red-tailed hawk	3	0
3	Red-tailed hawk[2/]	3	0
4	Red-tailed hawk	2	0
5	Red-tailed hawk	3	0
6	Red-tailed hawk	2	0
7	American kestrel	1	0
8	American kestrel	1	0
9	American kestrel	2	0
10	American kestrel	1	0
11	Great horned owl	1	2
12	Great horned owl	2	0
13	Great horned owl	0	2
14	Great horned owl	0	3
15	Great horned owl	0	1
16	Great horned owl	0	2
17	Great horned owl	1	3
18	Common raven	-	3
19	Common raven	-	2
20	Common raven	-	2
21	American kestrel	0	3
22	Marsh hawk	0	4
23	Marsh hawk	0	3
24	Cooper's hawk	2	1
25	American kestrel	0	2
26	Golden eagle	0	1
27	Marsh hawk	0	4

Table 3-7-253. (Continued)

Nest Number	Species	Contents of Nest Eggs	Contents of Nest Chicks
28	Cooper's hawk	0	2
29	Goshawk	0	1
30	American kestrel	0	2
31	Golden eagle	0	1

1/ Specific locations of all raptor nests discovered to date have been recorded.

2/ Nest and contents destroyed.

3) Status of Raptor Species in the Tract C-a Study Area

a) Turkey Vulture - Two turkey vultures were observed in the study area during summer and fall, 1975 sampling periods. This species is highly migratory within the western states (Brown and Amadon, 1968) and the majority of individuals leave Colorado by late September (Bent, 1961). The one individual observed during fall was probably a straggler. Turkey vultures have not been observed near Tract C-a during the winter.

The turkey vulture utilizes many habitat types and hunts over a wide area. Carrion comparises most of its diet, although it will kill young mammals and has been known to feed on insects (Grossmand and Hamlet, 1964). Its presence on Tract C-a and adjacent areas during the breeding season indicates that it is probably nesting in small numbers in the vicinity. No nests have been encountered, but potential nest sites exist on Tract C-a and adjacent areas. The preferred nesting sites are generally located in places inaccessible to predatory animals,or where the eggs and/or young cannot easily be reached (Bent, 1961). These sites tend to be cliffs, caves, hollow stumps, or in the midst of dense shrubbery (Bent, 1961; Brown and Amadon, 1968). In such locations, the vulture lays its eggs with little or no attempt to construct a nest (Bent, 1961).

b) Northern Bald Eagle - The bald eagle was observed within the study area during February but was not observed again through the remainder of the winter. This eagle was observed by ECI personnel within other areas of the basin along Piceance Creek during March, so it appears to be an uncommon winter resident of the Piceance Basin. Bald eagles were not recorded after March. The subspecies winters as far north as open water and food are available (Brown and Amadon, 1968). It nests only rarely in Colorado; most northern bald eagles nest in northern North America (Grossman and Hamlet, 1964). Tract C-a and environs do not provide suitable nesting habitat for this species since it prefers tall trees or large cliff faces in proximity to water (Bent, 1961; Brown and Amadon, 1968). Cathedral Bluffs, an area west of Tract C-a, provides possible nesting sites, but the rarity of the northern bald eagle as a Colorado summer resident indicates that it is an improbable nesting species along the Bluffs.

c) Golden Eagle - Golden eagles have been recorded within the study area throughout the year. This species hunts over open country and shows a strong preference for mammals in its diet (Brown and Amadon, 1968). According to results of a current study on the status of the golden eagle in western states (Boeker, 1974), the golden eagle population in Colorado, on a year-round basis, is 5.3 eagles per 1,000 sq mi. This is one of the highest desnities among the western states. The Tract C-a vicinity supported at least four adult golden eagles during the 1975 breeding season (Table 3-7-253); probably a few additional birds winter within the study area. Two active nests located on the study area each contained a single eaglet. It is difficult to ascertain from the total number of golden eagle sightings recorded outside of the breeding season how many individual golden eagles were actually observed. The home range of a golden eagle varies from 19 mi^2 in California to 200 mi^2 in heavily forested areas located in northeastern North America (Brown and Amadon, 1968). The home range size is dependent on such factors as prey density, season, and percentage of the range suitable for hunting (Brown and Amadon, 1968; Gordon, 1955).

d) Marsh Hawk - Field activities during 1974 and 1975 have substantiated that the marsh hawk is a fairly common raptor during the

breeding season but is infrequently observed during the winter. To date, three marsh hawk nests have been located in the study area (Table 3-7-253). The marsh hawk is a bird of open fields and marshes and avoids heavily forested areas (Burleigh, 1972). This species is a ground nester. The Tract C-a area probably supports more pairs than the three noted during 1975, but the nest of this species is difficult to locate because of the marsh hawk's preference for placing its nest on the ground in tall grass and shrubs. The pastures and sparsely vegetated mountain shrub stands within the study area provide suitable nesting habitat for this harrier.

This hawk is a migratory species in some parts of its geographical range, and a year-round resident in other areas (Bent, 1961). Davis (1969) describes the marsh hawk as an uncommon summer and common winter resident in western Colorado. Our data indicate that within the study area, the marsh hawk is a common summer resident and an uncommon winter resident.

e) Sharp-Shinned Hawk - Only one sharp-shinned hawk, recorded during summer 1975, has been observed on the study area. Davis (1969) described the sharp-shinned hawk as a common winter and rare summer resident. This accipiter prefers to nest in dense stands of conifers (Brown and Amadon, 1968; Grossman and Hamlet, 1967). There is little suitable nesting habitat for this small accipiter within the study area, but the open nature of much of the area should make it attractive as winter habitat for sharp-shinned hawks. Its apparent absence from the study area during the winter does not correspond with some of the literature for western Colorado (Davis, 1969). Until further field investigations are completed, it must be concluded that the status of the sharp-shinned hawk in the region is uncertain.

f) Cooper's Hawk - The Cooper's hawk has been observed fairly frequently during the spring and summer. It has not been recorded during fall and winter, but it has been observed during the fall in areas close to Tract C-a by ECI personnel. Davis (1969) described the Cooper's hawk as a common winter and rare summer resident in western Colorado. The Cooper's hawk is principally a woodland species (Burleigh, 1972) but it also nests in large shrubs such as Gambel oak (Bent, 1961). Two nests have been found within pinyon-juniper woodlands in the Tract C-a area (Table 3-7-253).

g) Goshawk - One pair of goshawks has been observed at their nest in an aspen grove along Cathedral Bluffs. Davis (1969) described this species as a rare resident of heavily wooded areas in western Colorado. Twomey (1942) indicated that the goshawk ranges from aspen habitats to timberline in eastern Utah. The goshawk generally nests in dense coniferous or deciduous forests adjacent to clearings (Brown and Amadon, 1968), where it feeds on large and medium-sized birds and mammals. Bent (1961) stated that, unlike other accipiters, the goshawk showed a definite preference for deciduous woods. Due to the scarcity of dense deciduous forests in the study area, the nesting goshawk population is probably small and limited to the Cathedral Bluffs area. This species has not been recorded during the winter.

h) Red-Tailed Hawk - Although few red-tailed hawks have been observed during aerial censuses, ground observations indicate this buteo is one of the most common raptors in the study area. The adult red-tailed hawk is opportunistic in its predatory habits, feeding on a variety of small mammal species. Its population levels generally fluctuate with changes in the local prey density (Craighead and Craighead, 1969). Brown and Amadon (1968) suggest the red-tailed hawk has the widest ecological tolerance of any buteo and perhaps of any hawk in North America. It resides in a greater variety of habitat types and has one of the widest distributions of any hawk in North America. The species does, however, show a preference for ecotone areas supporting trees (Brown and Amadon, 1968). This phenomenon is illustrated within the study area, where the red-tailed hawk frequents the various drainages with mixed brush bottoms and adjacent pinyon-juniper slopes. Its favored nesting site in the area is sandstone cliffs associated with pinyon-juniper woodlands, but an occasional nest is located in a mature pinyon pine or juniper. Six red-tailed hawk nests were located on the study area during April. All contained 2 or 3 eggs (Table 3-7-253). Red-tailed hawks are most abundant during the spring and summer, but a few individuals over-winter within the study area.

i) Swainson's Hawk - One Swainson's hawk was observed during summer 1975. Both Davis (1969) and Twomey (1942) refer to this species as an

uncommon summer resident and migrant in western Colorado and eastern Utah. Davis (1969) stated that occasionally a few Swainson's hawks winter in western Colorado.

j) Rough-Legged Hawk - Rough-legged hawks are common wintering raptors in the Tract C-a vicinity. This hawk appeared in the area by late November, 1974 and remained through the winter. Davis (1969) reported this species as an uncommon winter visitor in western Colorado and Twomey (1942) observed rough-legged hawks in the Uinta Basin, Utah only during migrations. According to Craighead and Craighead (1969), the presence of these birds in large numbers may indicate high populations of small rodents, which compromise the majority of this species' diet. The rough-legged hawk departed the Piceance Basin sometime between mid-March and early-August. Bent (1961) explained that the melting snow reveals the runways of voles, the major prey species of the rough-legged hawk.

k) Prairie Falcon - Seven sightings of prairie falcons have been recorded within the study area. The prairie falcon is a cliff nester and inhabits treeless areas, nesting rarely up to 12,000 ft elevation. The actual nest site is usually a ledge with some overhang, a pothole, or a cave (Brown and Amadon, 1968). Although no eyries have been recorded, the possibility of a pair of prairie falcons nesting within the study area exists. The most suitable nesting sites are the cliff faces along the western edge of Cathedral Bluffs. The rest of the study area shows poor nesting potential for this species. The prairie falcon is an uncommon nester in northwestern Colorado. The Colorado Division of Wildlife's ongoing raptor survey has identified a few eyries within the Piceance Basin north of the study area. Mr. Gerald Craig, Chief Raptor Biologist for the Division, indicated that the nesting prairie falcon population is sparse, and he does not think it is likely that many eyries exist in northwestern Colorado (personal communication, 1975). Until recently, this falcon was classified as "threatened" by the Federal government.

In winter, the prairie falcon moves to lower, windswept, winter wheat areas, where horned larks concentrate. Horned larks constitute the principal winter food of this falcon (Brown and Amadon, 1968). The numerous horned larks occurring on the study area during winter might explain the presence of the one prairie falcon recorded in December. The presence of this bird indicates that it is a rare winter resident within the study area.

l) Peregrine Falcon - The peregrine falcon, classified as an endangered species (United States Department of the Interior, "Threatened Wildlife of the United States," 1973), was observed four times within the study area during spring and summer 1975. The peregrine falcon is considered a rare resident breeder in northwest Colorado (Bailey and Niedrach, 1965). Mr. Gerald Craig (personal communication, 1975) noted that this species has nested and fledged young from eyries in northern Colorado and possibly nests in an area about 32 km (20 mi) southeast of Tract C-a. Enderson and Craig's (1974) treatise on the status of the peregrine falcon in the Rocky Mountains demonstrated that this species has experienced a population decline over the last few decades. The likelihood of a peregrine falcon nesting within the study area is remote, due to the lack of large cliff faces and the paucity of water within the area (G. Craig, personal communication, 1975).

The peregrine falcons observed during April and August may have been migrants. The species' northerly migration from Central and South America generally takes place in March and April (Brown and Amadon, 1968). The peregrine falcons observed during July could have been unpaired individuals or nesting adults. According to Mr. Craig (personal communication, 1975), a peregrine falcon could possibly hunt 33 km from its eyrie, so these individuals could have been associated with the suspected eyrie located within this radius of Tract C-a.

m) Merlin - The merlin was recorded five times during the October, 1975 sampling period within bald and mixed brush vegetation types. It has not been recorded during other sampling periods. This falcon is a rare winter visitor in western Colorado and was formerly a summer resident of the region (Davis, 1969). It is a bird of open country and is seldom

found within forested areas unless there are large open spaces interspersed in the stand (Brown and Amadon, 1968). It preys chiefly on small birds, especially the inhabitants of the ground or low vegetation such as horned larks and finches (Brown and Amadon, 1968). The merlin's major breeding range is north of the continental United States. The majority of merlins winter in the southern United States, the Carribbean, and northern South America (Bent, 1961). However, eastern Colorado supports a small wintering population.

The height of the fall migration is between mid-September and mid-October, coinciding with the height of songbird migration (Bent, 1961; Brown and Amadon, 1968). The individuals recorded on the study area during fall, 1975 were probably migrants, resting and feeding on Cathedral Bluffs for a few days.

n) American Kestrel - The American kestrel, one of the most abundant raptors encountered during the spring, summer,and fall, was observed throughout the study area. Seven kestrel nests have been located. The four nests found during April each contained one or two eggs and the three nests located in June each contained two or three chicks. Unlike most falcons, the kestrel will nest in deserted woodpecker holes and hollow trees as well as on cliff faces (Craighead and Craighead, 1969; Cooper, 1974). The small cliff faces scattered throughout the sampling area and the stands of pinyon-juniper woodland could support a substantial nesting population of kestrels. The kestrel's diet during the breeding season consists primarily of mice, small birds, and insects (Craighead and Craighead, 1969). Kestrels have been observed in low numbers in the study area during winter. A number of authors (Bent, 1961; Heintzelman and Nagy, 1968) have suggested that a low percentage of American kestrels over-winter within their breeding areas. This depends primarily on food availability; their winter diet generally consists largely of meadow mice (Craighead and Criaghead, 1969).

o) Common Raven - The common raven is the most abundant resident raptor within the study area. It is a fairly common bird of the mountains in western Colorado (Bailey and Niedrach, 1965; Davis, 1969).

Three raven nests were located and due to the large numbers of ravens encountered during the summer, many other active nests certainly exist. The preferred nesting site is a crevice in a cliff face (Burleigh, 1972). These next sites are in such inaccessible places that locating them is often difficult. The raven is primarily a scavenger and commonly competes with magpies and eagles for carrion (Bailey and Neidrach, 1965); however, it also takes prey (Bent, 1964c). They are found in large numbers throughout the year in the study area and are particularly gregarious during winter. It is not unusual to see flocks of 10 or more ravens at one time during the fall and winter.

p) Screech Owl - One screech owl was recorded during the December, 1974 night owl transect. This species prefers well-wooded creek bottoms and open woodland adjacent to grainfields, meadows, brushland, or grassy valleys (Karalus and Eckert, 1974). It is an uncommon resident in western Colorado (Davis, 1969). Screech owls are most active directly after sunset, and feed primarily on frogs and mice. They roost during summer days on branches in heavy tree foliage and in natural tree hollows during winter (Karalus and Eckert, 1974). Although only one individual was recorded on the study area, the screech owl is probably an uncommon resident of Piceance Basin. It is not a migratory species (Karalus and Eckert, 1974), yet there are times when seasonal movements have been recorded. These movements are largely dependent upon the severity of winter and prey availability (Karalus and Eckert, 1974).

q) Great Horned Owl - The great horned owl is the most abundant nocturnal raptor within the study area. Three great horned owls were recorded during the December 1974 night owl transects and one was recorded during the April, 1975 transects. Many opportunistic sightings have been made in a variety of habitats throughout the year. This species is a locally common resident in woodlands throughout western Colorado (Davis, 1969). The great horned owl and the red-tailed hawk often inhabit and hunt the same territory, the hawk by day, the owl by night (Orians and Kuhlman, 1956).

Although the great horned owl generally hunts at night, it is apt to be seen on the wing during all times of day. The great horned owl has one of the most varied diets of any North American raptor. It will eat almost any live prey but will rarely scavenge. It shows a preference for rodents, cottontail rabbits, skunks, crows, and other owls (Craighead and Craighead, 1969; Karalus and Eckert, 1974).

The nest of a great horned owl is generally an abandoned red-tailed hawk nest on cliffs or tall trees. The many small sandstone cliffs and stands of pinyon pines and junipers within the study area provide ample nesting sites for this species. Seven great horned owl nests were discovered, all of which contained eggs and/or young (Table 3-7-253). The great horned owl is one of the earliest nesting raptors; its courtship begins in November or early December (Karalus and Eckert, 1974). This species is essentially non-migratory (Orians and Kuhlman, 1956), but during severe winters when prey becomes difficult to find, some seasonal movements occur (Karalus and Eckert, 1974).

r) Pygmy Owl - One pygmy owl was recorded during the December, 1974 night owl transect. Davis (1969) described this species as an uncommon, rarely-observed resident of mountain forests in western Colorado. It sometimes comes down into the lower valleys in winter. It feeds primarily on small and medium-sized birds and small mammals (Karalus and Eckert, 1974). The pygmy owl is a cavity nester and ordinarily uses the abandoned hole of a hairy woodpecker or common flicker (Scott and Patton, 1975). The presence of the pygmy owl during December indicates that this species is a winter resident; due to the paucity of sightings, its status is undetermined.

s) Short-eared Owl - Two short-eared owls were recorded during the December, 1974 night owl transect. The short-eared owl is an uncommon winter visitor to open fields in western Colorado (Davis, 1969) where it feeds primarily on meadow voles. The short-eared owl, unlike the great horned owl and screech owl, is a restricted feeder; it feeds principally on one or two prey species (Craighead and Craighead, 1969; Karalus and Eckert, 1974). Although grassy fields and marshlands are its preferred habitat, the short-eared owl is often found in a variety of habitats ranging

from the alpine tundra to city parks. The short-eared owl does not generally breed in northwestern Colorado (Davis, 1969; Karalus and Eckert, 1974).

4. Discussion - The largest number of birds and the greatest number of species encountered during the two fall sampling periods occurred within the rabbitbrush, greasewood/sagebrush, Douglas-fir, and riparian vegetation types. The pinyon-juniper (south slope), mixed brush (north slope), upland meadow, and sagebrush (flat) types exhibited a paucity of species and low total numbers of birds during October, 1974 and 1975 (Tables 3-7-216 through 3-7-251). The mountain bluebird, mountain chickadee, gray-headed junco, dark-eyed junco, horned lark, white-crowned sparrow, and yellow-rumped warbler were observed in greater numbers than any other species during the autumn surveys.

The October, 1974 sampling period probably occurred near the end of the fall migration for most bird species. Some migrating birds such as the mountain bluebird, western meadowlark, and white-crowned sparrow were still present in the study area. A greater number of summer resident species was present during the October, 1975 census period. The mild fall weather that occurred during 1975 probably resulted in later migratory exodus in comparison with the 1974 fall migration.

The bottomland meadow, mixed brush (south slope), pinyon-juniper (north slope), and Douglas-fir vegetation types supported the largest number of birds and the greatest species diversity during the two winter sampling periods. The sagebrush (flat and north slope), pinyon-juniper/mixed brush, pinyon-juniper (south slope), upland meadow, and the greasewood/sagebrush vegetation types exhibited few or no birds during the two winter censuses.

Migratory species encountered in October had departed the area of investigation by winter, while more northern migratory species such as the northern shrike and tree sparrow had migrated into the region after the fall sampling period. The black-billed magpie, common raven, red-breasted nuthatch, and mountain chickadee were the most abundant species within the study area during the winter.

The December census results exemplified the sparseness of birds, which is typical of these portions of the temperate region during late fall and winter. The avifauna encountered during February included species which are probably typical of Tract C-a's habitats during winter. The mid-winter avifauna was comprised of 23 species, all of which were observed in low numbers. The horned lark, pinyon jay, mountain chickadee, red-breasted nuthatch and the tree sparrow comprised about 60% of all individuals observed.

During April, the largest number of birds and the greatest number of species were encountered in aspen, Douglas-fir, south slope pinyon-juniper, greasewood/sagebrush, riparian, and bottomland meadow vegetation types. The bottomland types exhibited low species diversity and low numbers of birds during this sampling period (Tables 3-7-216 through 3-7-251). Strip transect censuses documented the presence of 27 species during April. Qualitative count surveys along with all other field censuses conducted in early spring accounted for an additional 34 species. The April sampling period occurred near the starting point of the spring migration for most bird species. Many summer residents such as the mourning dove, Say's phoebe, western wood pewee, tree swallow, rough-winged swallow, barn swallow, yellow-rumped warbler, orange-crowned warbler, Virginia's warbler, and green-tailed towhee had appeared in small numbers.

Results of the April censuses were thus a composite of late winter and early spring populations. Many areas showed the uneven pattern of bird distribution typical of the winter, while other areas hosted a considerable variety of species and numbers. Wintering species such as the rough-legged hawk, northern shrike, and tree sparrow had begun migration northward. The tree swallow, rough-winged swallow, barn swallow, pinyon-jay, mountain chickadee, mountain bluebird, yellow-rumped warbler, red-winged blackbird, dark-eyed junco, gray-headed junco, vesper sparrow, and chipping sparrow were the most frequently observed species during the early spring field sampling period. Of these, the mountain bluebird and gray-headed junco were exploiting

a wider range of vegetation types than were other species. These 12 species accounted for more than 65% of the birds observed during the early spring surveys.

As with the fall migration period, any census of avian species during a transition stage must be analyzed with caution. During these transitory periods, species migrating in flocks tend to move along certain topographic features such as a drainage, river valley, canyon, etc. Species comprising these flocks generally display a less specific attachment to favored habitat than they exhibit during the breeding season. The uneven distributional pattern of avian species in large areas of favored habitat can further be explained by inclement weather and the tendency for species to form large intermixed flocks during migration (Lack, 1960; Graber and Graber, 1963; Graber, 1968; Brewer, 1972).

During summer, the largest number of birds and the greatest species diversity were encountered within the riparian, bottomland meadow, Douglas-fir, aspen, and all pinyon-juniper vegetation types (Tables 3-7-216 through 3-7-251). The rabbitbrush, sagebrush, mixed brush, and upland meadow vegetation types supported fewer species and low total numbers of birds in comparison with the aforementioned vegetation types. June censuses occurred during the height of the breeding season for most species. The variety of vegetation types present in the study area provided suitable nesting sites for many species, as demonstrated by the relatively high diversity recorded during the summer season. Of the 96 species recorded during this sampling period, 42 species were not present during autumn, winter, or spring censuses. The mountain bluebird, green-tailed towhee, chipping sparrow, Brewer's sparrow, and vesper sparrow were the most frequently observed species during the summer sampling period.

On an annual basis, the riparian community and adjacent habitats supported the greatest bird density and diversity throughout the year, while the sagebrush and rabbitbrush communities supported the lowest number of species and individuals.

In the southwest portions of the study area, a relatively large population of sage grouse exists on a year-round basis within areas of upland sagebrush and mixed brush vegetation types. There also is a relatively large population of blue grouse along Cathedral Bluffs. The blue grouse primarily inhabits upland meadow, mixed brush, and aspen/mixed brush ecotonal areas during the breeding seasons; during winter, it frequents dense stands of Douglas-fir and aspen. The mourning dove is the most widely distributed gamebird within the study area during the breeding and migration periods. During these seasons, it was observed in a variety of habitats, with the greater number of individuals noted in pinyon-juniper and greasewood/sagebrush vegetation types.

In the Tract C-a vicinity, a few surface ponds and intermittent streams create isolated islands of habitat for waterfowl and shorebirds. Because surface water is restricted in distribution in northwestern Colorado, such habitat types have an unusually high ecological value in this region. Fourteen waterfowl and shorebird species were recorded within the Tract C-a vicinity. Although usage of the area by waterfowl and shorebirds is greater during late spring and summer than during fall, the overall waterbird population within the study area is small. The paucity of open water is undoubtedly a major limiting factor on the size of the resident and migratory waterfowl populations. The mallard, green-winged teal, blue-winged teal, killdeer, and common snipe were the most common waterfowl and shorebirds utilizing surface waters of the area.

The distribution of raptors observed during the aerial surveys demonstrated a number of interesting trends. The majority of raptors were recorded within the eastern half of the study area, along the drainages. Frequently observed raptors were the raven, rough-legged hawk, and golden eagle. Aerial surveys were not conducive for sightings of small, low flying raptors such as accipiters and falcons. Thus, the few small, low-flying raptors recorded during aerial surveys were not a fair indication of the relative abundance of these birds of prey on the study area. Fourteen diurnal and four nocturnal

raptors were encountered between October, 1974 and October, 1975. The red-tailed hawk was frequently observed during all times of the year except during the late winter sampling period. The rough-legged hawk was the most common wintering raptor. This species breeds on the arctic tundra, so it was not present during summer. The golden eagle was observed frequently throughout the year. A greater number of golden eagle observations occurred during winter than during other seasons, suggestive of a winter concentration in the Piceance Basin. The marsh hawk and American kestrel were common nesters and a few individuals were recorded during the winter. The common raven was the species recorded most frequently throughout the year; it was present in all vegetation types within the study area. Other diurnal raptors observed less frequently were the turkey vulture, goshawk, sharp-shinned hawk, Cooper's hawk, Swainson's hawk, bald eagle, prairie falcon, merlin, and peregrine falcon.

The night owl surveys demonstrated the presence of four nocturnal raptor species, the pygmy owl, short-eared owl, screech owl, and great horned owl. The latter is the most common owl within the study area and was encountered in a variety of vegetation types.

Thirty-one active nest sites were located on the study area during the raptor nesting survey. Six red-tailed hawk, seven American kestrel, seven great horned owl, three common raven, three marsh hawk, two Cooper's hawk, two golden eagle, and one goshawk nests were encountered.

The year's census data indicate that most species encountered in the area of investigation are those expected to be present based on published information from northwestern Colorado and northeastern Utah (Bailey and Niedrach, 1965; Davis, 1969; Hayward, 1967; Hendee, 1929; Twomey, 1942).

Several unexpected species were observed. Most have been recorded previously in northwestern Colorado, but only as unusual occurrences.

- White-faced Ibis - Two individuals were observed in bottomland areas where seepages or annual streams occur. The first bird, observed on April 17, was foraging along the stream bottom in Corral Gulch 1 km west of 84 Mesa Ranch. The second bird, observed on April 26, was observed near a spring seepage in Little Duck Creek. Both birds were photographed. The white-faced ibis, occurring in very small numbers, is probably a regular migrant in both spring and fall to northwestern Colorado. Twomey (1942) found this species to be a common spring migrant to the Uinta Basin area of Utah. Davis (1969) considers the bird to be a rare visitor to the western slope, while Bailey and Niedrach (1965) list white-faced ibis records only for Gunnison County, Colorado. Martin, Baldwin, and Reed (1974) observed individual flocks of 8-15 and 42 birds at ponds in the vicinity of Hayden, Colorado, in early April and early May, 1973 respectively.
- Sora - On June 6 and 11, 1975, soras were observed at the Stake Springs Draw pond. Davis (1969) described the sora as an uncommon summer resident of the cattail swamps in western Colorado.
- Long-billed Curlew - On June 2, 1975 a long-billed curlew was recorded in a flooded pasture along Ryan Gulch. This species is considered rare west of the Colorado Continental Divide (Bailey and Niedrach, 1965). Martin, et al. (1974) recorded one individual on agricultural fields near Craig during the summer of 1971.

- Short-eared Owl - Two individuals were encountered during the owl census conducted December 17, 1975. Davis (1969) classified this species as an uncommon winter visitor to open fields. The species was noted by Rockwell (1908) in the winter of 1904-05 in Mesa County. Felger (1910) observed a pair in Moffat County in April, 1924. Twomey (1942) reported that one short-eared owl was seen at the Ashley Creek marshes of northeastern Utah in late September 1937.
- Red-Eyed Vireo - Two red-eyed vireos were recorded in an aspen stand along Cathedral Bluffs during a qualitative survey. This species is a rare visitor to western Colorado (Bailey and Niedrach, 1965; Martin, et al., 1974). Its preferred nesting habitat in western United States appears to be the cottonwood-willow river bottom. The paucity of this vegetative type in the Piceance Basin is probably the major limiting factor on the basin's red-eyed vireo population.
- Bobolink - The bobolink, an unusual species for this area, was recorded once during June. Since the habitat of the bobolink is limited rather strictly in the intermountain area to western pasturelands, its distribution in Colorado seems to be spotty and it has not previously been recorded in the Piceance Basin. Although little or no cultivated land is found within the study area, the observed bobolink was probably a wanderer from the agricultural lands along Piceance Creek.
- McCown's Longspur - This species was observed on Cathedral Bluffs in October and again in February. McCown's longspur is a local breeder in eastern Colorado but was not listed as occurring in western Colorado by either Davis (1969) or Bailey and Niedrach (1965).
- Chestnut-Collared Longspur - A single individual was recorded during a strip transect census through the upland meadow habitat during October, 1974, and two individuals were recorded within this transect during June, 1975. Bailey and Niedrach (1965) indicated this species is a local breeder in Weld County, eastern Colorado. They list only a single record of the chestnut-collared longspur for western Colorado.

• Snow Bunting - A flock of 32 snow buntings was observed on Cathedral Bluffs during February. A search of the literature on species recorded from western Colorado indicated that this sighting is probably the first record for this species in northwestern Colorado.

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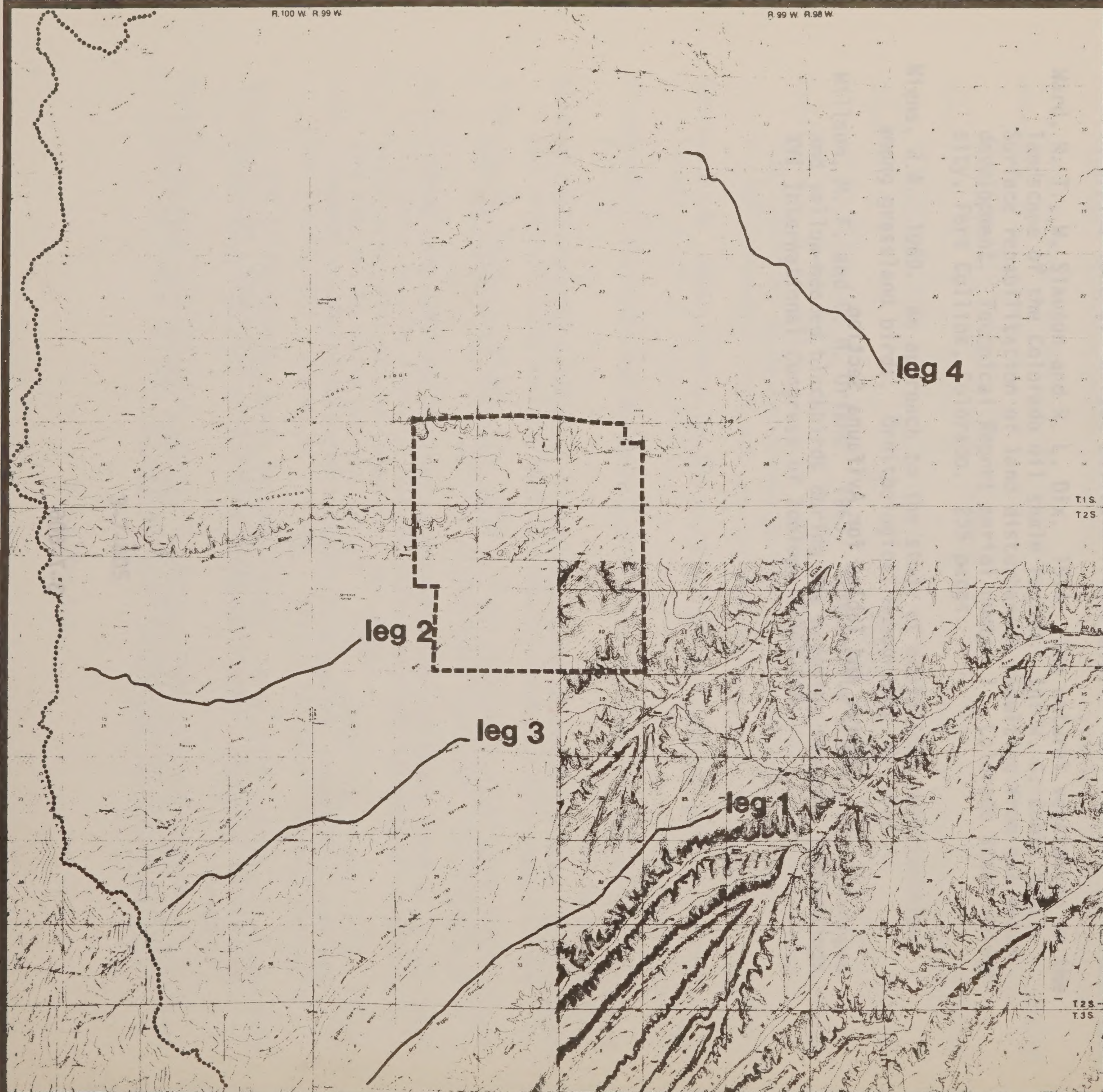
Figures and Tables for Avifauna Section

Figure 3-7-62

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

GROUSE SURVEY



—— SAGE GROUSE SURVEY

.... BLUE GROUSE SURVEY

0 1/2 1 2 miles

NORTH

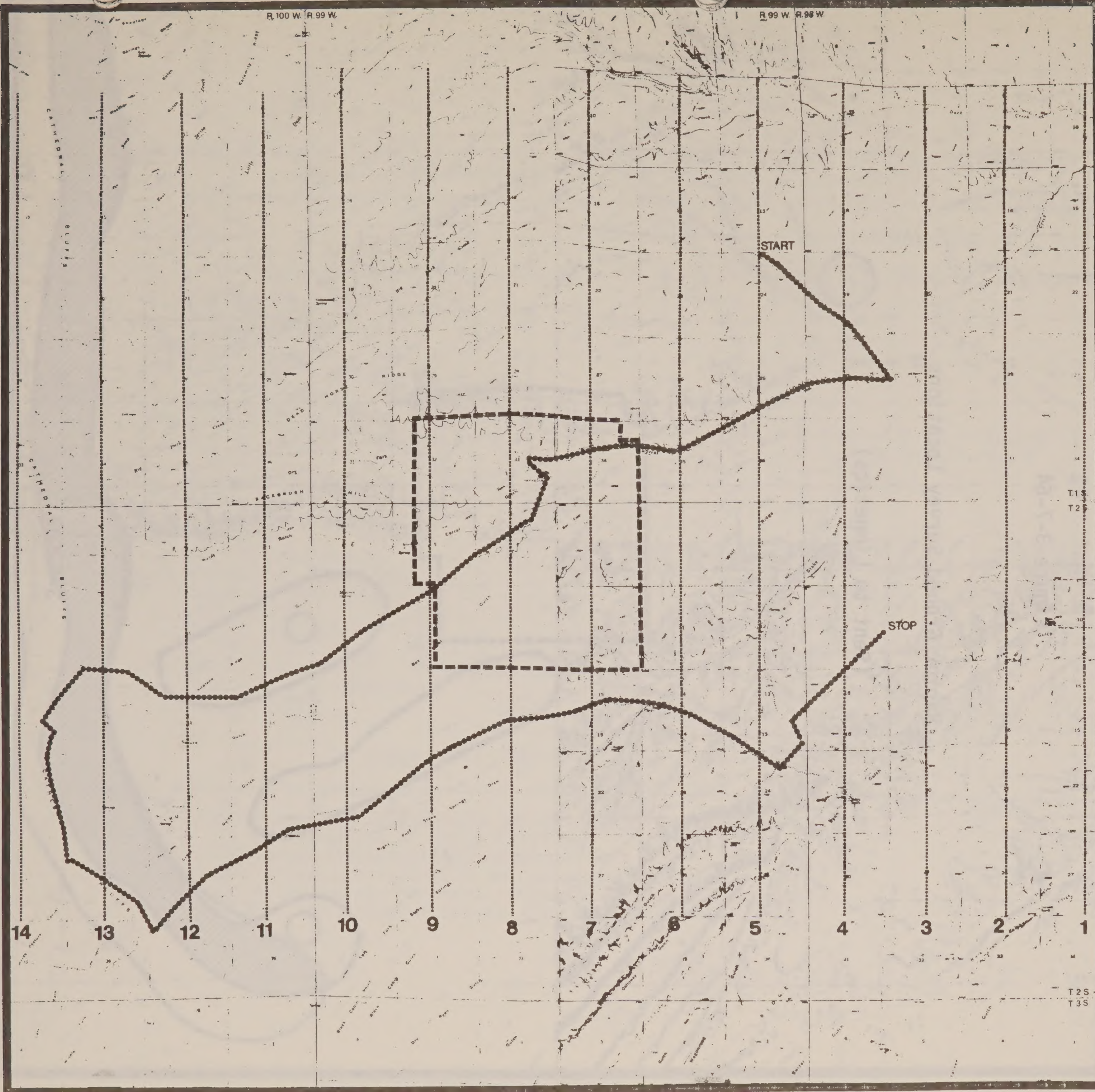
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

Figure 3-7-63

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

RAPTOR SURVEY



north-south raptor transects (aerial)

owl night count transects (ground)

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

Figure 3-7-64

Raptor Ground Survey Locations

(Sent to Limnetics)

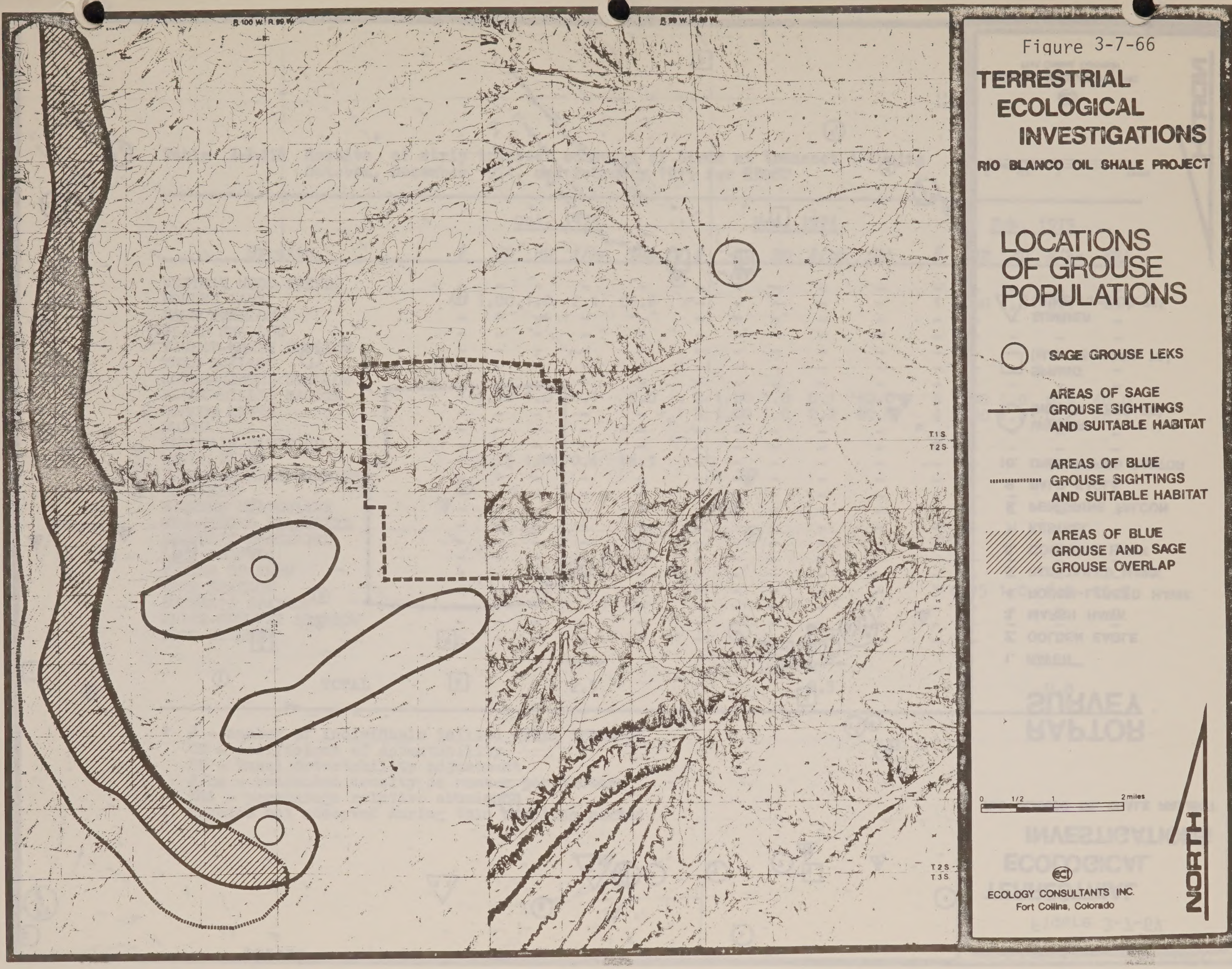


Figure 3-7-66
TERRESTRIAL ECOLOGICAL INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
LOCATIONS OF GROUSE POPULATIONS
SAGE GROUSE LEKS
AREAS OF SAGE GROUSE SIGHTINGS AND SUITABLE HABITAT
AREAS OF BLUE GROUSE SIGHTINGS AND SUITABLE HABITAT
AREAS OF BLUE GROUSE AND SAGE GROUSE OVERLAP
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R.100 W. R.99 W.
R.99 W. R.98 W.
T1S
T2S
T2S
T3S

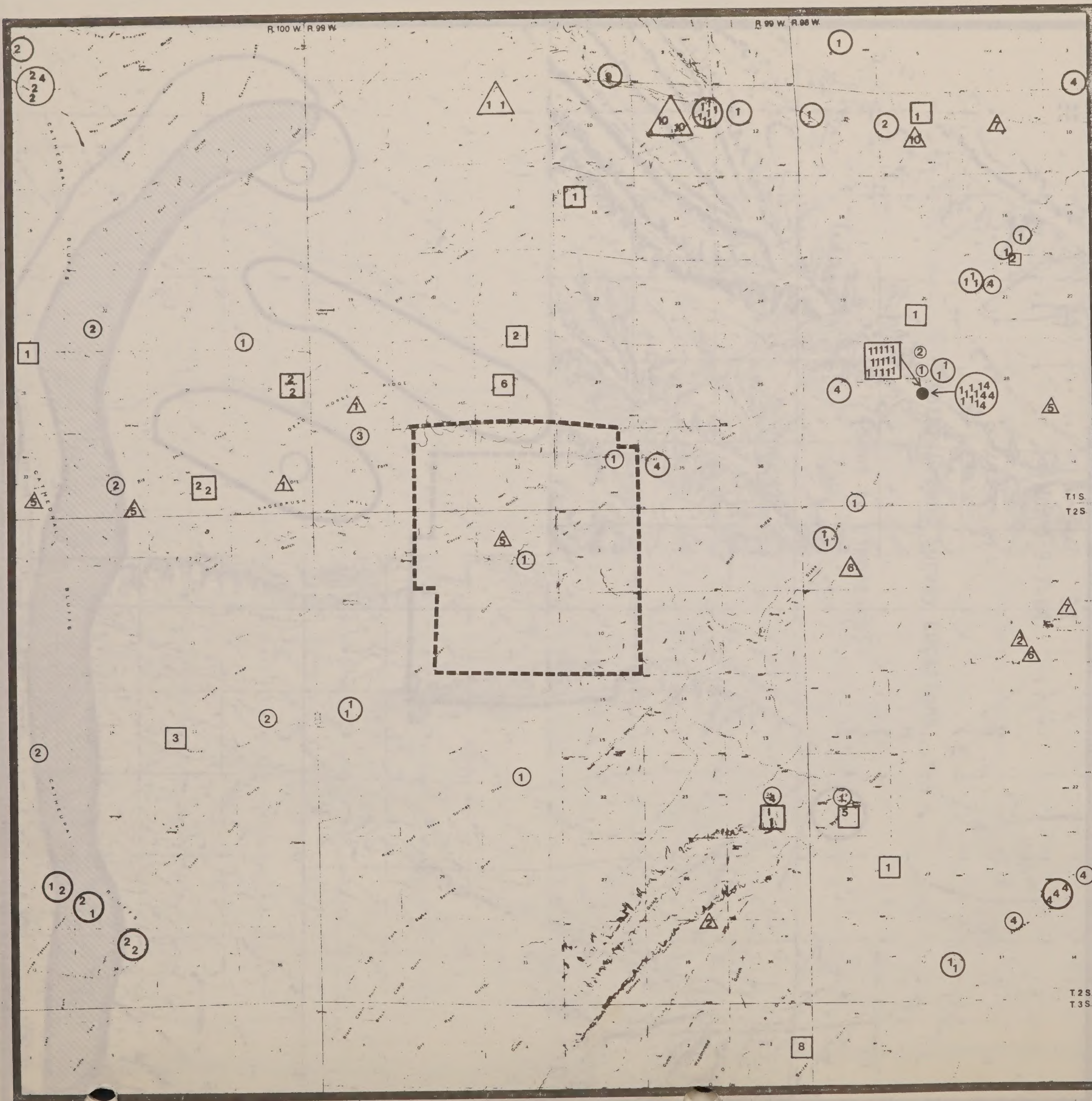


Figure 3-7-67

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

RAPTOR SURVEY

1. RAVEN
2. GOLDEN EAGLE
3. MARSH HAWK
4. ROUGH-LEGGED HAWK
5. RED-TAILED HAWK
6. COOPER'S HAWK
7. KESTREL
8. PEREGRINE FALCON
9. BALD EAGLE
10. UNIDENTIFIED RAPTOR

○ WINTER (NOV. 74 – FEB. 75)

□ SPRING (MAR. 75 – APRIL 75)

△ SUMMER (JUNE 75 – AUG. 75)

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

Table 3-7-216 Results* of strip transect censuses of birds at transect 1 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974 #	CD	BD	#/ha	%RA	Dec. 1974 #	CD	BD	#/ha	%RA	Feb. 1975 #	CD	BD	#/ha	%RA
WESTERN WOOD PEEWEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HORNED LARK	40	1.00	1.0	2.1	81.6	-	-	-	-	-	1	1.00	1.0	0.1	6.7
BARN SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VIOLET-GREEN SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TREE SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-BILLED MAGPIE	1	1.00	1.0	0.1	2.0	2	1.00	1.0	0.1	40.0	6	1.00	1.0	0.3	40.0
COMMON RAVEN	-	-	-	-	-	3	1.00	1.0	0.2	60.0	4	1.00	1.0	0.2	26.7
ROBIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WATER PIPIT	1	0.13	1.0	0.4	16.3	-	-	-	-	-	-	-	-	-	-
YELLOW-RUMPED WARBLER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOBOLINK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WESTERN MEADOWLARK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RED-WINGED BLACKBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BREWER'S BLACKBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LARK BUNTING	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TREE SPARROW	-	-	-	-	-	-	-	-	-	-	3	0.75	1.0	0.2	26.7
BREWER'S SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHITE-CROWNED SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SONG SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				2.5					0.3					0.8	

* # = number of individuals tallied along transect
CD = coefficient of detectability
BD = basal detectability adjustment
#/ha = estimated density as number per hectare
%RA = percentage relative abundance
\- Species not observed during this sampling period

Table 3-7-217* Results of strip transect censuses of birds at transect 1 during April, June and October 1975 for RBOSP

Species	Apr. 1975 #	CD	BD	#/ha	%RA	June 1975 #	CD	BD	#/ha	%RA	Oct. 1975 #	CD	BD	#/ha	%RA
WESTERN WOOD PEEWEE	1	0.13	1.0	0.4	32.0	-	-	-	-	-	-	-	-	-	-
HORNED LARK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BARN SWALLOW	-	-	-	-	-	2	1.00	1.0	0.1	1.3	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	4	1.00	1.0	0.2	2.7	-	-	-	-	-
VIOLET-GREEN SWALLOW	-	-	-	-	-	3	1.00	1.0	0.2	2.0	-	-	-	-	-
TREE SWALLOW	-	-	-	-	-	1	1.00	1.0	0.1	0.7	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	9	1.00	1.0	0.5	6.0	-	-	-	-	-
BLACK-BILLED MAGPIE	-	-	-	-	-	2	1.00	1.0	0.1	1.3	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	2	1.00	1.0	0.1	1.3	1	1.00	1.0	0.1	4.3
ROBIN	3	1.00	1.0	0.2	12.0	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	1	1.00	1.0	0.1	4.0	2	1.00	1.0	0.1	1.3	5	1.00	1.0	0.3	21.7
WATER PIPIT	-	-	-	-	-	1	0.13	1.0	0.4	5.3	-	-	-	-	-
YELLOW-RUMPED WARBLER	-	-	-	-	-	2	1.00	1.0	0.1	1.3	-	-	-	-	-
BOBOLINK	-	-	-	-	-	1	0.13	1.0	0.4	5.3	-	-	-	-	-
WESTERN MEADOWLARK	1	0.25	1.0	0.2	16.0	3	0.38	1.0	0.4	5.3	10	1.00	1.0	0.5	43.5
RED-WINGED BLACKBIRD	9	1.00	1.0	0.5	36.0	9	1.00	1.0	0.5	6.0	7	1.00	1.0	0.4	30.4
BREWER'S BLACKBIRD	-	-	-	-	-	18	1.00	1.0	0.9	12.0	-	-	-	-	-
LARK BUNTING	-	-	-	-	-	1	0.13	1.0	0.4	5.3	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	4	0.25	1.0	0.8	10.7	-	-	-	-	-
TREE SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	4	0.25	1.0	0.8	10.7	-	-	-	-	-
WHITE-CROWNED SPARROW	-	-	-	-	-	3	0.19	1.0	0.8	10.7	-	-	-	-	-
SONG SPARROW	-	-	-	-	-	4	0.25	1.0	0.8	10.7	-	-	-	-	-
TOTAL				1.3					7.7					1.2	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-218 Results* of strip transect censuses of birds at transect 2 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974 #	CD	BD	#/ha	%RA	Dec. 1974 #	CD	BD	#/ha	%RA	Feb. 1975 #	CD	BD	#/ha	%RA
HORNED LARK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LARK BUNTING	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LARK SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAGE SPARROW	2	0.13	1.2	1.0	100.0	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				1.0					0.0					0.0	

Table 3-7-219 Results* of strip transect censuses of birds at transect 2 during April, June and October 1975 for RBOSP

Species	Apr. 1975 #	CD	BD	#/ha	%RA	June 1975 #	CD	BD	#/ha	%RA	Oct. 1975 #	CD	BD	#/ha	%RA
HORNED LARK	3	0.25	1.0	0.6	100.0	-	-	-	-	-	1	0.25	1.2	0.2	12.8
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	9	0.32	1.0	1.4	74.5
LARK BUNTING	-	-	-	-	-	1	0.25	1.0	0.2	10.0	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	2	0.50	1.5	0.3	15.0	-	-	-	-	-
LARK SPARROW	-	-	-	-	-	1	0.06	1.0	0.8	40.0	-	-	-	-	-
SAGE SPARROW	-	-	-	-	-	-	-	-	-	-	1	0.25	1.2	0.2	12.8
BREWER'S SPARROW	-	-	-	-	-	7	0.50	1.0	0.7	35.0	-	-	-	-	-
TOTAL				0.6					2.1					1.9	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-220 Results* of strip transect censuses of birds at transect 3 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
WHITE-THROATED SWIFT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	2.9
PINYON JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	3	1.00	1.0	0.2	8.8
BUSHTIT	-	-	-	-	-	-	-	-	-	-	25	1.00	1.2	1.5	88.2
MOUNTAIN BLUEBIRD	7	0.15	1.0	2.5	33.3	-	-	-	-	-	-	-	-	-	-
RUBY-CROWNED KINGLET	2	0.13	1.0	0.8	11.1	-	-	-	-	-	-	-	-	-	-
YELLOW-RUMPED WARBLER	2	0.13	1.0	0.8	11.1	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUFOUS-SIDED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	13	0.41	1.0	1.6	22.2	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHITE-CROWNED SPARROW	8	0.25	1.0	1.6	22.2	-	-	-	-	-	-	-	-	-	-
GOLDEN-CROWNED SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				7.4					0.0					1.7	

Table 3-7-221 Results* of strip transect censuses of birds at transect 3 during April, June and October 1975 for RBOSP

Species	Apr. 1975					June 1975					Oct. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
WHITE-THROATED SWIFT	-	-	-	-	-	1	1.00	1.0	0.1	1.0	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	7	1.00	1.0	0.4	6.7	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	1	1.00	1.0	0.1	1.0	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	-	-	-	-	-	6	1.00	1.0	0.3	3.4
PINYON JAY	-	-	-	-	-	-	-	-	-	-	7	1.00	1.0	0.4	4.0
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	5	0.16	1.0	1.6	18.1
BUSHTIT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	3	0.25	1.0	0.6	83.3	3	0.38	1.0	0.4	7.6	3	0.75	1.0	0.2	2.3
RUBY-CROWNED KINGLET	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YELLOW-RUMPED WARBLER	-	-	-	-	-	-	-	-	-	-	2	0.13	1.0	0.8	9.0
GREEN-TAILED TOWHEE	-	-	-	-	-	3	0.19	1.0	0.8	15.2	-	-	-	-	-
RUFOUS-SIDED TOWHEE	1	0.50	1.2	0.1	16.7	-	-	-	-	-	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	2	0.13	1.0	0.8	9.0
GRAY-HEADED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	15	0.21	1.0	3.7	68.6	-	-	-	-	-
WHITE-CROWNED SPARROW	-	-	-	-	-	-	-	-	-	-	11	0.14	1.0	4.1	45.2
GOLDEN-CROWNED SPARROW	-	-	-	-	-	-	-	-	-	-	4	0.25	1.0	0.8	9.0
TOTAL				0.7					5.4					9.1	

* See Table 3-7-216 for footnotes

\- Species not observed during this sampling period

Table 3-7-222 Results* of strip transect censuses of birds at transect 4 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974 #	CD	BD	#/ha	%RA	Dec. 1974 #	CD	BD	#/ha	%RA	Feb. 1975 #	CD	BD	#/ha	%RA
COMMON FLICKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PINYON JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-BILLED MAGPIE	1	1.00	1.0	0.1	11.1	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLUE-GRAY GNATCATCHER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUFOUS-SIDED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DARK-EYED JUNCO	1	0.13	1.0	0.4	88.9	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				0.5					0.0					0.0	

Table 3-7-223 Results* of strip transect censuses of birds at transect 4 during April, June and October 1975 for RBOSP

Species	Apr. 1975 #	CD	BD	#/ha	%RA	June 1975 #	CD	BD	#/ha	%RA	Oct. 1975 #	CD	BD	#/ha	%RA
COMMON FLICKER	-	-	-	-	-	2	1.00	1.0	0.1	2.9	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	2	1.00	1.0	0.1	2.9	2	1.00	1.0	0.1	4.0
PINYON JAY	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	2.0
BLACK-BILLED MAGPIE	-	-	-	-	-	2	1.00	1.0	0.1	2.9	1	1.00	1.0	0.1	2.0
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	2	0.13	1.0	0.8	32.3
MOUNTAIN BLUEBIRD	-	-	-	-	-	3	0.13	1.0	1.2	34.3	1	0.25	1.0	0.2	8.1
BLUE-GRAY GNATCATCHER	-	-	-	-	-	1	0.13	1.0	0.4	11.4	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	5	0.31	1.0	0.8	22.9	-	-	-	-	-
RUFOUS-SIDED TOWHEE	-	-	-	-	-	-	-	-	-	-	1	0.13	1.2	0.5	19.4
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	2	0.13	1.0	0.8	32.3
BREWER'S SPARROW	-	-	-	-	-	4	0.25	1.0	0.8	22.9	-	-	-	-	-
TOTAL				0.0					3.6					2.5	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period

Table 3-7-224 Results* of strip transect censuses of birds at transect 5 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
WHITE-THROATED SWIFT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-BILLED MAGPIE	-	-	-	-	-	18	1.00	1.0	0.9	90.0	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	2	1.00	1.0	0.1	10.0	-	-	-	-	-
MOUNTAIN CHICKADEE	2	0.25	1.0	0.4	33.3	-	-	-	-	-	-	-	-	-	-
HOUSE WREN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ROBIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLUE-GRAY GNATCATCHER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NORTHERN SHRIKE	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	100.0
GREEN-TAILED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	5	0.31	1.0	0.8	66.7	-	-	-	-	-	-	-	-	-	-
TOTAL				1.2					1.0					0.1	

Table 3-7-225 Results* of strip transect censuses of birds at transect 5 during April, June and October 1975 for RBOSP

Species	Apr. 1975					June 1975					Oct. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
WHITE-THROATED SWIFT	-	-	-	-	-	1	1.00	1.0	0.1	1.8	-	-	-	-	-
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	2	0.25	1.5	0.6	21.4	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	-	-	-	-	-	2	1.00	1.0	0.1	3.0
BLACK-BILLED MAGPIE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HOUSE WREN	-	-	-	-	-	3	1.00	1.0	0.2	5.4	-	-	-	-	-
ROBIN	-	-	-	-	-	-	-	-	-	-	1	0.25	1.0	0.2	6.1
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	8	0.40	1.0	1.0	30.3
BLUE-GRAY GNATCATCHER	-	-	-	-	-	2	0.06	1.0	1.6	57.1	-	-	-	-	-
NORTHERN SHRIKE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	3	0.38	1.0	0.4	14.3	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	5	0.13	1.0	2.1	60.6
GRAY-HEADED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				0.0					2.9					3.4	

* See Table 3-7-216 for footnotes

\- Species not observed during this sampling period

Table 3-7-226 Results* of strip transect censuses of birds at transect 6 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HORNED LARK	70	0.29	1.0	12.3	93.4	-	-	-	-	-	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TREE SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCRUB JAY	1	1.00	1.0	0.1	0.4	-	-	-	-	-	-	-	-	-	-
PINYON JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	1	0.25	1.0	0.2	1.6	3	0.38	1.0	0.4	100.0	-	-	-	-	-
BUSHTIT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	6	0.50	1.0	0.6	4.7	-	-	-	-	-	-	-	-	-	-
BLUE-GRAY GNATCATCHER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUFOUS-SIDED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LARK SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAGE SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				13.2					0.4					0.0	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-227 Results* of strip transect censuses of birds at transect 6 during April, June and October 1975 for RBOSP

	Apr. 1975					June 1975					Oct. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	1	0.25	1.5	0.3	4.2	-	-	-	-	-
HORNED LARK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	8	1.00	1.0	0.4	5.6	-	-	-	-	-
TREE SWALLOW	-	-	-	-	-	3	1.00	1.0	0.2	2.1	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	2	1.00	1.0	0.1	1.4	3	1.00	1.0	0.2	3.3
PINYON JAY	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	1.1
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	2	1.00	1.0	0.1	2.2
COMMON RAVEN	-	-	-	-	-	1	1.00	1.0	0.1	0.7	-	-	-	-	-
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUSHTIT	-	-	-	-	-	-	-	-	-	-	4	0.13	1.2	2.0	42.9
MOUNTAIN BLUEBIRD	-	-	-	-	-	6	0.25	1.0	1.2	16.7	1	0.50	1.0	0.1	2.2
BLUE-GRAY GNATCATCHER	-	-	-	-	-	3	0.13	1.0	1.2	16.7	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	3	0.19	1.0	0.8	11.1	-	-	-	-	-
RUFOUS-SIDED TOWHEE	-	-	-	-	-	-	-	-	-	-	3	0.13	1.2	1.5	32.1
VESPER SPARROW	-	-	-	-	-	4	0.33	1.0	0.6	8.3	-	-	-	-	-
LARK SPARROW	-	-	-	-	-	2	0.13	1.0	0.8	11.1	-	-	-	-	-
SAGE SPARROW	-	-	-	-	-	-	-	-	-	-	3	0.25	1.2	0.7	16.1
BREWER'S SPARROW	-	-	-	-	-	10	0.31	1.0	1.6	22.2	-	-	-	-	-
TOTAL				0.0					7.4					4.6	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period

Table 3-7-228 Results* of strip transect censuses of birds at transect 7 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
HORNED LARK	4	0.25	1.0	0.8	40.0	+	+	+	+	+	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
WHITE-CROWNED SPARROW	2	0.13	1.0	0.8	40.0	+	+	+	+	+	-	-	-	-	-
CHESTNUT COLLARED LONGSPUR	1	0.13	1.0	0.4	20.0	+	+	+	+	+	-	-	-	-	-
TOTAL				2.1										0.0	

Table 3-7-229 Results* of strip transect censuses of birds at transect 7 during April, June and October 1975 for RBOSP

Species	Apr. 1975					June 1975					Oct. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
HORNED LARK	3	1.00	1.0	0.2	100.0	9	1.00	1.0	0.5	14.3	23	0.25	1.0	4.7	100.0
MOUNTAIN BLUEBIRD	-	-	-	-	-	2	1.00	1.0	0.1	3.2	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	1	0.25	1.0	0.2	6.3	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	3	0.19	1.0	0.8	25.4	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	2	0.13	1.0	0.8	25.4	-	-	-	-	-
WHITE-CROWNED SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHESTNUT COLLARED LONGSPUR	-	-	-	-	-	2	0.13	1.0	0.8	25.4	-	-	-	-	-
TOTAL				0.2					3.2					4.7	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-230 Results* of strip transect censuses of birds at transect 8 during October, December 1974, and February 1975 for RBOSP

	Oct. 1974					Dec. 1974					Feb. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
MOURNING DOVE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMON FLICKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	1	1.00	1.0	0.1	100.0	-	-	-	-	-
PINYON JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAGE THRASHER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
YELLOW-RUMPED WARBLER	5	0.31	1.0	0.8	54.1	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LARK SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TREE SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIPPING SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHITE-CROWNED SPARROW	1	0.25	1.0	0.2	13.5	-	-	-	-	-	-	-	-	-	-
SONG SPARROW	1	0.13	1.2	0.5	32.4	-	-	-	-	-	-	-	-	-	-
TOTAL				1.5					0.1					0.0	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

3-7-621

Table 3-7-231 Results* of strip transect censuses of birds at transect 8 during April, June and October 1975 for RBOSP

	Apr. 1975					June 1975					Oct. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
MOURNING DOVE	-	-	-	-	-	3	1.00	1.0	0.2	1.5	-	-	-	-	-
COMMON FLICKER	-	-	-	-	-	-	-	-	-	-	2	1.00	1.0	0.1	1.5
CLIFF SWALLOW	-	-	-	-	-	2	1.00	1.0	0.1	1.0	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	3	1.00	1.0	0.2	1.5	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	1	1.00	1.0	0.1	0.5	2	1.00	1.0	0.1	1.5
PINYON JAY	-	-	-	-	-	-	-	-	-	-	7	1.00	1.0	0.4	5.2
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	0.7
COMMON RAVEN	-	-	-	-	-	1	1.00	1.0	0.1	0.5	2	1.00	1.0	0.1	1.5
SAGE THRASHER	3	0.38	1.0	0.4	2.7	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	4	0.17	1.0	1.2	8.1	-	-	-	-	-	7	0.18	1.0	2.1	29.5
YELLOW-RUMPED WARBLER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	4	0.17	1.0	1.2	12.2	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	1	0.25	1.5	0.3	3.1	3	0.19	1.2	1.0	14.2
LARK SPARROW	-	-	-	-	-	2	0.50	1.0	0.2	2.0	-	-	-	-	-
DARK-EYED JUNCO	22	0.15	1.0	7.4	48.6	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	22	0.18	1.0	6.2	40.5	-	-	-	-	-	-	-	-	-	-
TREE SPARROW	-	-	-	-	-	-	-	-	-	-	2	0.13	1.0	0.8	11.8
CHIPPING SPARROW	-	-	-	-	-	2	0.06	1.5	2.5	24.5	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	21	0.26	1.0	4.1	40.8	2	0.06	1.2	2.0	28.3
WHITE-CROWNED SPARROW	-	-	-	-	-	-	-	-	-	-	1	0.13	1.0	0.4	5.9
SONG SPARROW	-	-	-	-	-	3	0.19	1.5	1.2	12.2	-	-	-	-	-
TOTAL				15.2					10.0					6.9	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period

Table 3-7-232 Results* of strip transect censuses of birds at transect 9 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
MOURNING DOVE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHITE-THROATED SWIFT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMON FLICKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TREE SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCRUB JAY	1	1.00	1.0	0.1	20.0	-	-	-	-	-	-	-	-	-	-
PINYON JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	1	0.25	1.0	0.2	80.0	-	-	-	-	-	-	-	-	-	-
BUSHTIT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY VIREO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SOLITARY VIREO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-THROATED GRAY WARBLER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				0.3					0.0					0.0	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-233 Results* of strip transect censuses of birds at transect 9 during April, June and October 1975 for RBOSP

Species	Apr. 1975					June 1975					Oct. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
MOURNING DOVE	-	-	-	-	-	7	1.00	1.0	0.4	5.5	-	-	-	-	-
WHITE-THROATED SWIFT	-	-	-	-	-	2	1.00	1.0	0.1	1.6	-	-	-	-	-
COMMON FLICKER	-	-	-	-	-	2	1.00	1.0	0.1	1.6	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	6	1.00	1.0	0.3	4.7	-	-	-	-	-
TREE SWALLOW	-	-	-	-	-	2	1.00	1.0	0.1	1.6	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	1	1.00	1.0	0.1	0.8	-	-	-	-	-
SCRUB JAY	1	1.00	1.0	0.1	6.7	4	1.00	1.0	0.2	3.1	4	1.00	1.0	0.2	11.1
PINYON JAY	13	1.00	1.0	0.7	86.7	-	-	-	-	-	-	-	-	-	-
COMMON RAVEN	1	1.00	1.0	0.1	6.7	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BUSHTIT	-	-	-	-	-	2	0.13	1.5	1.2	18.8	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	4	0.13	1.0	1.6	25.0	7	0.22	1.0	1.6	88.9
GRAY VIREO	-	-	-	-	-	2	0.13	1.0	0.8	12.5	-	-	-	-	-
SOLITARY VIREO	-	-	-	-	-	2	0.13	1.0	0.8	12.5	-	-	-	-	-
BLACK-THROATED GRAY WARBLER	-	-	-	-	-	3	0.19	1.0	0.8	12.5	-	-	-	-	-
TOTAL				0.8					6.6					1.8	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-234 Results* of strip transect censuses of birds at transect 10 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMON FLICKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY FLYCATCHER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	5	1.00	1.0	0.3	100.0	2	1.00	1.0	0.1	2.0
BLACK-BILLED MAGPIE	1	1.00	1.0	0.1	2.3	-	-	-	-	-	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	4	0.17	1.0	1.2	54.3	-	-	-	-	-	9	0.19	1.0	2.5	49.0
PLAIN TITMOUSE	-	-	-	-	-	-	-	-	-	-	4	0.17	1.0	1.2	24.5
WHITE-BREASTED NUTHATCH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RED-BREASTED NUTHATCH	-	-	-	-	-	-	-	-	-	-	10	0.42	1.0	1.2	24.5
ROBIN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RUBY-CROWNED KINGLET	1	0.06	1.2	1.0	43.4	-	-	-	-	-	-	-	-	-	-
SOLITARY VIREO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-THROATED GRAY WARBLER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BROWN-HEADED COWBIRD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRASSHOPPER SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIPPING SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				2.3					0.3					5.0	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period

Table 3-7-235 Results[*] of strip transect censuses of birds at transect 10 during April, June and October 1975 for RBOSP

	Apr. 1975					June 1975					Oct. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	1	0.13	1.5	0.6	5.2	-	-	-	-	-
COMMON FLICKER	-	-	-	-	-	3	1.00	1.0	0.2	1.3	-	-	-	-	-
GRAY FLYCATCHER	-	-	-	-	-	2	0.50	1.0	0.2	1.7	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-BILLED MAGPIE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	1.1
MOUNTAIN CHICKADEE	-	-	-	-	-	2	0.06	1.0	1.6	14.0	4	0.17	1.0	1.2	25.5
PLAIN TITMOUSE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WHITE-BREASTED NUTHATCH	-	-	-	-	-	-	-	-	-	-	1	0.50	1.0	0.1	2.1
RED-BREASTED NUTHATCH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ROBIN	-	-	-	-	-	-	-	-	-	-	1	0.50	1.0	0.1	2.1
MOUNTAIN BLUEBIRD	-	-	-	-	-	3	0.50	1.0	0.3	2.6	1	1.00	1.0	0.1	1.1
RUBY-CROWNED KINGLET	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SOLITARY VIREO	-	-	-	-	-	1	0.25	1.0	0.2	1.7	-	-	-	-	-
BLACK-THROATED GRAY WARBLER	-	-	-	-	-	8	0.33	1.0	1.2	10.5	-	-	-	-	-
BROWN-HEADED COWBIRD	-	-	-	-	-	2	1.00	1.0	0.1	0.9	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	2	0.25	1.0	0.4	3.5	-	-	-	-	-
GRASSHOPPER SPARROW	-	-	-	-	-	1	0.25	1.0	0.2	1.7	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	4	0.06	1.0	3.3	68.1
GRAY-HEADED JUNCO	-	-	-	-	-	1	0.13	1.0	0.4	3.5	-	-	-	-	-
CHIPPING SPARROW	-	-	-	-	-	7	0.09	1.5	6.2	52.4	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	1	0.50	1.0	0.1	0.9	-	-	-	-	-
TOTAL				0.0					11.7					4.8	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-236 Results* of strip transect censuses of birds at transect 11 during October, December 1974, and February 1975 for RBOSP

	Oct. 1974					Dec. 1974					Feb. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
COMMON FLICKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
HOUSE WREN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
ROBIN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
YELLOW-RUMPED WARBLER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
TOTAL				0.0										0.0	

Table 3-7-237 Results* of strip transect censuses of birds at transect 11 during April, June and October 1975 for RBOSP

	Apr. 1975					June 1975					Oct. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
COMMON FLICKER	-	-	-	-	-	1	1.00	1.0	0.1	1.1	2	1.00	1.0	0.1	1.6
SCRUB JAY	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	0.8
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	0.8
COMMON RAVEN	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	0.8
HOUSE WREN	-	-	-	-	-	1	0.50	1.0	0.1	2.2	-	-	-	-	-
ROBIN	-	-	-	-	-	-	-	-	-	-	4	1.00	1.0	0.2	3.2
MOUNTAIN BLUEBIRD	-	-	-	-	-	2	1.00	1.0	0.1	2.2	8	0.25	1.0	1.6	25.8
YELLOW-RUMPED WARBLER	-	-	-	-	-	-	-	-	-	-	7	0.11	1.0	3.3	51.5
GREEN-TAILED TOWHEE	-	-	-	-	-	9	0.38	1.0	1.2	25.8	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	4	0.25	1.5	1.2	25.8	2	0.13	1.2	1.0	15.5
BREWER'S SPARROW	-	-	-	-	-	17	0.43	1.0	2.1	43.0	-	-	-	-	-
TOTAL				0.0					4.8					6.4	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-238 Results* of strip transect censuses of birds at transect 12 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974 #	CD	BD	#/ha	%RA	Dec. 1974 #	CD	BD	#/ha	%RA	Feb. 1975 #	CD	BD	#/ha	%RA
COMMON FLICKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
STELLER'S JAY	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
MOUNTAIN BLUEBIRD	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
MACGILLIVRAY'S WARBLER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BLACK ROSY FINCH	-	-	-	-	-	+	+	+	+	+	13	0.25	1.0	2.7	36.1
BROWN-CAPPED ROSY FINCH	-	-	-	-	-	+	+	+	+	+	7	0.25	1.0	1.4	19.4
GREEN-TAILED TOWHEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
DARK-EYED JUNCO	20	0.13	1.0	8.2	33.3	+	+	+	+	+	-	-	-	-	-
GRAY-HEADED JUNCO	40	0.13	1.0	16.4	66.7	+	+	+	+	+	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
SNOW BUNTING	-	-	-	-	-	+	+	+	+	+	32	0.50	1.0	3.3	44.4
TOTAL				24.6										7.4	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period
+ Transect not sampled due to adverse weather conditions

3-7-627

Table 3-7-239 Results* of strip transect censuses of birds at transect 12 during April, June and October 1975 for RBOSP

Species	Apr. 1975 #	CD	BD	#/ha	%RA	June 1975 #	CD	BD	#/ha	%RA	Oct. 1975 #	CD	BD	#/ha	%RA
COMMON FLICKER	-	-	-	-	-	2	1.00	1.0	0.1	1.3	-	-	-	-	-
STELLER'S JAY	-	-	-	-	-	1	1.00	1.0	0.1	0.6	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	2	1.00	1.0	0.1	2.0
COMMON RAVEN	-	-	-	-	-	1	1.00	1.0	0.1	0.6	-	-	-	-	-
MOUNTAIN BLUEBIRD	2	0.25	1.0	0.4	11.1	-	-	-	-	-	7	0.07	1.0	4.9	98.0
MACGILLIVRAY'S WARBLER	-	-	-	-	-	2	0.06	1.0	1.6	20.5	-	-	-	-	-
BLACK ROSY FINCH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BROWN-CAPPED ROSY FINCH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	4	0.13	1.0	1.6	20.5	-	-	-	-	-
VESPER SPARROW	-	-	-	-	-	5	0.16	1.5	2.5	30.8	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	10	0.16	1.0	3.3	88.9	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	8	0.20	1.0	2.1	25.6	-	-	-	-	-
SNOW BUNTING	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL				3.7					8.0					5.0	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period

Table 3-7-240 Results[*] of strip transect censuses of birds at transect 13 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
DOWNY WOODPECKER	1	1.00	1.0	0.1	1.4	+	+	+	+	+	-	-	-	-	-
HAMMOND'S FLYCATCHER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
STELLER'S JAY	-	-	-	-	-	+	+	+	+	+	3	0.50	1.0	0.3	1.8
CLARK'S NUTCRACKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
COMMON RAVEN	1	1.00	1.0	0.1	1.4	+	+	+	+	+	-	-	-	-	-
BLACK-CAPPED CHICKADEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
MOUNTAIN CHICKADEE	-	-	-	-	-	+	+	+	+	+	16	0.29	1.0	2.9	16.9
RED-BREASTED NUTHATCH	-	-	-	-	-	+	+	+	+	+	34	C.28	1.0	6.2	36.3
PYGMY NUTHATCH	-	-	-	-	-	+	+	+	+	+	19	0.16	1.0	6.2	36.3
HOUSE WREN	-	-	-	-	-	+	+	+	+	+	3	0.13	1.2	1.5	8.7
ROBIN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
HERMIT THRUSH	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
RUBY-CROWNED KINGLET	3	0.25	1.2	0.7	19.9	+	+	+	+	+	-	-	-	-	-
CASSIN'S FINCH	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
PINE SISKIN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
RED CROSSBILL	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
DARK-EYED JUNCO	3	0.19	1.0	0.8	22.1	+	+	+	+	+	-	-	-	-	-
GRAY-HEADED JUNCO	13	0.33	1.0	2.1	55.2	+	+	+	+	+	-	-	-	-	-
TOTAL				3.7										17.0	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period
\+ Transect not sampled due to adverse weather conditions

Table 3-7-241 Results* of strip transect censuses of birds at transect 13 during April, June and October 1975 for RBOSP

	Apr. 1975					June 1975					Oct. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
DOWNY WOODPECKER	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	1.5
HAMMOND'S FLYCATCHER	-	-	-	-	-	3	0.25	1.0	0.6	4.5	-	-	-	-	-
STELLER'S JAY	1	0.25	1.0	0.2	4.3	4	0.17	1.0	1.2	9.0	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	4	1.00	1.0	0.2	6.1
COMMON RAVEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-CAPPED CHICKADEE	4	0.17	1.0	1.2	26.1	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	7	0.15	1.0	2.5	52.2	4	0.13	1.0	1.6	12.0	-	-	-	-	-
RED-BREASTED NUTHATCH	3	0.19	1.0	0.8	17.4	4	0.13	1.0	1.6	12.0	2	0.25	1.0	0.4	12.2
PYGMY NUTHATCH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HOUSE WREN	-	-	-	-	-	3	0.19	1.0	0.8	6.0	-	-	-	-	-
ROBIN	-	-	-	-	-	3	0.38	1.0	0.4	3.0	1	0.06	1.0	0.8	24.3
HERMIT THRUSH	-	-	-	-	-	4	0.33	1.5	0.9	6.8	1	0.25	1.2	0.2	7.3
RUBY-CROWNED KINGLET	-	-	-	-	-	4	0.25	1.5	1.2	9.0	-	-	-	-	-
CASSIN'S FINCH	-	-	-	-	-	1	0.13	1.0	0.4	3.0	-	-	-	-	-
PINE SISKIN	-	-	-	-	-	5	0.16	1.0	1.6	12.0	-	-	-	-	-
RED CROSSBILL	-	-	-	-	-	3	0.13	1.5	1.8	13.5	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	-	-	-	-	-	4	0.17	1.0	1.2	9.0	4	0.13	1.0	1.6	48.6
TOTAL				4.7					13.6					3.4	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period

3-7-629

Table 3-7-242 Results* of strip transect censuses of birds at transect 14 during October, December 1974, and February 1975 for RBOSP

Species	Oct. 1974					Dec. 1974					Feb. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
GREAT HORNED OWL	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
WHITE-THROATED SWIFT	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
COMMON FLICKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
DOWNY WOODPECKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	+	+	+	+	+	1	1.00	1.0	0.1	5.9
BLACK-CAPPED CHICKADEE	1	0.25	1.0	0.2	5.5	+	+	+	+	+	5	0.31	1.0	0.8	94.1
MOUNTAIN CHICKADEE	5	0.16	1.0	1.6	44.0	+	+	+	+	+	-	-	-	-	-
HOUSE WREN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
TOWNSEND'S SOLITAIRE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
RUBY-CROWNED KINGLET	1	0.25	1.2	0.2	6.6	+	+	+	+	+	-	-	-	-	-
WARBLING VIREO	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
TENNESSEE WARBLER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
ORANGE-CROWNED WARBLER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
MACGILLIVRAY'S WARBLER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BLACK-HEADED GROSBEAK	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
RUFOUS-SIDED TOWHEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
GRAY-HEADED JUNCO	6	0.19	1.0	1.6	44.0	+	+	+	+	+	-	-	-	-	-
TOTAL				3.7										0.9	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period
\+ Transect not sampled due to adverse weather conditions

Table 3-7-243 Results* of strip transect censuses of birds at transect 14 during April, June and October 1975 for RBOSP

Species	Apr. 1975 #	CD	BD	#/ha	%RA	June 1975 #	CD	BD	#/ha	%RA	Oct. 1975 #	CD	BD	#/ha	%RA
GREAT HORNED OWL	-	-	-	-	-	1	1.00	1.0	0.1	0.4	-	-	-	-	-
WHITE-THROATED SWIFT	-	-	-	-	-	2	1.00	1.0	0.1	0.7	-	-	-	-	-
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	3	0.09	1.5	2.5	17.8	-	-	-	-	-
COMMON FLICKER	1	1.00	1.0	0.1	0.8	2	1.00	1.0	0.1	0.7	-	-	-	-	-
DOWNY WOODPECKER	1	1.00	1.0	0.1	0.8	1	1.00	1.0	0.1	0.4	-	-	-	-	-
CLARK'S NUTCRACKER	-	-	-	-	-	-	-	-	-	-	1	1.00	1.0	0.1	2.0
COMMON RAVEN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BLACK-CAPPED CHICKADEE	3	0.13	1.0	1.2	20.3	3	0.19	1.0	0.8	5.9	-	-	-	-	-
MOUNTAIN CHICKADEE	14	0.25	1.0	2.9	47.5	2	0.06	1.0	1.6	11.9	4	0.50	1.0	0.4	16.3
HOUSE WREN	-	-	-	-	-	1	0.25	1.0	0.2	1.5	-	-	-	-	-
TOWNSEND'S SOLITAIRE	-	-	-	-	-	-	-	-	-	-	2	0.25	1.0	0.4	16.3
RUBY-CROWNED KINGLET	-	-	-	-	-	3	0.09	1.5	2.5	17.8	-	-	-	-	-
WARBLING VIREO	-	-	-	-	-	5	0.21	1.0	1.2	8.9	-	-	-	-	-
TENNESSEE WARBLER	-	-	-	-	-	3	0.19	1.0	0.8	5.9	-	-	-	-	-
ORANGE-CROWNED WARBLER	-	-	-	-	-	1	0.06	1.5	1.2	8.9	-	-	-	-	-
MACGILLIVRAY'S WARBLER	-	-	-	-	-	1	0.06	1.0	0.8	5.9	-	-	-	-	-
BLACK-HEADED GROSBEAK	-	-	-	-	-	2	0.13	1.0	0.8	5.9	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	1	0.13	1.0	0.4	3.0	-	-	-	-	-
RUFOUS-SIDED TOWHEE	-	-	-	-	-	1	0.13	1.5	0.6	4.4	-	-	-	-	-
DARK-EYED JUNCO	3	0.25	1.0	0.6	10.2	-	-	-	-	-	-	-	-	-	-
GRAY-HEADED JUNCO	12	0.50	1.0	1.2	20.3	-	-	-	-	-	4	0.13	1.0	1.6	65.3
TOTAL				6.0					13.8					2.5	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period

Table 3-7-244 Results* of strip transect censuses of birds at transect 15 during October, December 1974, and February 1975 for RBOSP.

	Oct. 1974					Dec. 1974					Feb. 1975				
Species	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
MOURNING DOVE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
WESTERN WOOD PEEWEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
SCRUB JAY	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BLACK-BILLED MAGPIE	1	1.00	1.0	0.1	0.5	+	+	+	+	+	-	-	-	-	-
COMMON RAVEN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
MOUNTAIN CHICKADEE	3	0.13	1.0	1.2	10.9	+	+	+	+	+	-	-	-	-	-
ROBIN	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
MOUNTAIN BLUEBIRD	20	0.67	1.0	1.5	13.7	+	+	+	+	+	-	-	-	-	-
BLUE-GRAY GNATCATCHER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
WATER PIPIT	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
STARLING	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
ORANGE-CROWNED WARBLER	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
YELLOW-RUMPED WARBLER	30	0.21	1.0	7.4	65.6	+	+	+	+	+	-	-	-	-	-
WESTERN MEADOWLARK	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
RED-WINGED BLACKBIRD	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BREWER'S BLACKBIRD	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
CASSIN'S FINCH	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
DARK-EYED JUNCO	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
GRAY-HEADED JUNCO	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-
WHITE-CROWNED SPARROW	3	1.00	1.0	0.2	1.4	+	+	+	+	+	-	-	-	-	-
FOX SPARROW	1	0.13	1.0	0.4	3.6	+	+	+	+	+	-	-	-	-	-
SONG SPARROW	1	0.13	1.2	0.5	4.4	+	+	+	+	+	-	-	-	-	-
TOTAL				11.3										0.0	

* See Table 3-7-216 for footnotes
\- Species not observed during this sampling period
\+ Transect not sampled due to adverse weather conditions

Table 3-7-245 Results* of strip transect censuses of birds at transect 15 during April, June and October 1975 for RBOSP

Species	Apr. 1975					June 1975					Oct. 1975				
	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA	#	CD	BD	#/ha	%RA
MOURNING DOVE	-	-	-	-	-	4	1.00	1.0	0.2	0.7	-	-	-	-	-
BROAD-TAILED HUMMINGBIRD	-	-	-	-	-	1	0.06	1.5	1.2	4.2	-	-	-	-	-
WESTERN WOOD PEEWEE	1	0.50	1.0	0.1	0.4	-	-	-	-	-	-	-	-	-	-
CLIFF SWALLOW	-	-	-	-	-	20	1.00	1.0	1.0	3.5	-	-	-	-	-
ROUGH-WINGED SWALLOW	-	-	-	-	-	1	1.00	1.0	0.1	0.2	-	-	-	-	-
SCRUB JAY	2	1.00	1.0	0.1	0.4	-	-	-	-	-	1	1.00	1.0	0.1	0.5
BLACK-BILLED MAGPIE	2	1.00	1.0	0.1	0.4	-	-	-	-	-	-	-	-	-	-
COMMON RAVEN	4	1.00	1.0	0.2	0.9	-	-	-	-	-	-	-	-	-	-
MOUNTAIN CHICKADEE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ROBIN	7	0.29	1.0	1.2	5.3	7	0.22	1.0	1.6	5.6	-	-	-	-	-
MOUNTAIN BLUEBIRD	13	0.20	1.0	3.3	14.0	-	-	-	-	-	2	1.00	1.0	0.1	1.0
BLUE-GRAY GNATCATCHER	-	-	-	-	-	5	0.25	1.0	1.0	3.5	-	-	-	-	-
WATER PIPIT	3	1.00	1.0	0.2	0.7	-	-	-	-	-	-	-	-	-	-
STARLING	3	1.00	1.0	0.2	0.7	-	-	-	-	-	-	-	-	-	-
ORANGE-CROWNED WARBLER	-	-	-	-	-	1	0.13	1.5	0.6	2.1	-	-	-	-	-
YELLOW-RUMPED WARBLER	-	-	-	-	-	1	0.25	1.0	0.2	0.7	15	0.10	1.0	7.4	70.2
WESTERN MEADOWLARK	2	0.50	1.0	0.2	0.9	-	-	-	-	-	-	-	-	-	-
RED-WINGED BLACKBIRD	13	0.27	1.2	3.0	12.6	26	0.20	1.5	9.8	33.3	2	1.00	1.0	0.1	1.0
BREWER'S BLACKBIRD	-	-	-	-	-	3	1.00	1.0	0.2	0.5	-	-	-	-	-
CASSIN'S FINCH	-	-	-	-	-	2	0.06	1.0	1.6	5.6	-	-	-	-	-
GREEN-TAILED TOWHEE	-	-	-	-	-	5	0.31	1.0	0.8	2.8	-	-	-	-	-
DARK-EYED JUNCO	10	0.10	1.0	4.9	21.1	-	-	-	-	-	1	0.13	1.0	0.4	3.9
GRAY-HEADED JUNCO	25	0.13	1.0	9.8	42.1	-	-	-	-	-	-	-	-	-	-
BREWER'S SPARROW	-	-	-	-	-	24	0.25	1.0	4.9	16.7	-	-	-	-	-
WHITE-CROWNED SPARROW	-	-	-	-	-	-	-	-	-	-	3	0.06	1.0	2.5	23.4
FOX SPARROW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SONG SPARROW	1	0.50	1.2	0.1	0.5	9	0.11	1.5	6.2	20.8	-	-	-	-	-
TOTAL				23.4					29.5					10.5	

* See Table 3-7-216 for footnotes
- Species not observed during this sampling period

Table 3-7-246 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all avifauna transects during sample period 1, October 1974, for RBOSP

Transect Number	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	0.628	0.598	0.016	1.386	0.453
2	Sagebrush	0.000	0.000	0.000	0.000	-
3	Rabbitbrush	1.523	1.509	0.001	1.609	0.946
4	Pinyon-juniper/mixed brush	0.349	0.293	0.047	0.693	0.503
5	Mixed brush	0.637	0.616	0.004	0.693	0.918
6	Pinyon-juniper/sagebrush	0.293	0.288	0.003	1.386	0.212
7	Upland meadow	1.055	1.030	0.002	1.099	0.960
8	Greasewood-sagebrush	0.647	0.646	0.000	1.792	0.361
9	Pinyon-juniper (south slope)	0.868	0.701	0.071	1.099	0.790
10	Pinyon-juniper (north slope)	0.780	0.757	0.005	1.099	0.710
11	Sagebrush	0.000	-	-	-	-
12	Mixed brush	0.637	0.635	0.000	0.693	0.918
13	Douglas fir	1.101	1.073	0.007	1.609	0.684
14	Aspen	1.342	1.319	0.004	1.609	0.834
15	Riparian	1.155	1.139	0.005	2.079	0.556

\- Insufficient data for computation

Table 3-7-247 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all avifauna transects during sample period 2, December 1974, for RBOSP

Transect Number	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	1.277	1.063	0.030	1.386	0.921
2	Sagebrush	0.000	–	–	–	–
3	Rabbitbrush	0.000	–	–	–	–
4	Pinyon-juniper/mixed brush	0.000	–	–	–	–
5	Mixed brush	0.325	0.300	0.022	0.693	0.469
6	Pinyon-juniper/sagebrush	0.000	0.000	0.000	0.000	–
7	Upland meadow	*	*	*	*	*
8	Greasewood-sagebrush	0.000	0.000	0.000	0.000	–
9	Pinyon-juniper (south slope)	0.000	0.000	0.000	0.000	–
10	Pinyon-juniper (north slope)	0.451	0.367	0.060	0.693	0.650
11	Sagebrush	*	*	*	*	*
12	Mixed brush	*	*	*	*	*
13	Douglas fir	*	*	*	*	*
14	Aspen	*	*	*	*	*
15	Riparian	*	*	*	*	*

– Insufficient data for computation
* Transect not sampled due to adverse weather conditions

Table 3-7-248 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all avifauna transects during sample period 3, February 1975, for RBOSP

Transect Number	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	1.739	1.589	0.017	1.946	0.894
2	Sagebrush	0.000	-	-	-	-
3	Rabbitbrush	0.428	0.399	0.021	1.099	0.390
4	Pinyon-juniper/mixed brush	0.000	-	-	-	-
5	Mixed brush	0.000	0.000	0.000	0.000	-
6	Pinyon-juniper/sagebrush	0.000	-	-	-	-
7	Upland meadow	0.000	-	-	-	-
8	Greasewood-sagebrush	0.000	-	-	-	-
9	Pinyon-juniper (south slope)	0.000	-	-	-	-
10	Pinyon-juniper (north slope)	1.118	1.103	0.003	1.386	0.807
11	Sagebrush	0.000	-	-	-	-
12	Mixed brush	1.047	1.040	0.001	1.099	0.953
13	Douglas fir	1.322	1.316	0.001	1.609	0.821
14	Aspen	0.224	0.194	0.025	0.693	0.323
15	Riparian	0.000	0.000	0.000	0.000	-

\- Insufficient data for computation

Table 3-7-249 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all avifauna transects during sample period 4, April 1975, for RBOSP

Transect Number	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	1.621	1.545	0.007	1.792	0.905
2	Sagebrush	0.000	0.000	0.000	0.000	-
3	Rabbitbrush	0.451	0.416	0.025	0.693	0.650
4	Pinyon-juniper/mixed brush	0.000	-	-	-	-
5	Mixed brush	0.000	-	-	-	-
6	Pinyon-juniper/sagebrush	0.000	-	-	-	-
7	Upland meadow	0.000	0.000	0.000	0.000	-
8	Greasewood-sagebrush	1.018	1.013	0.001	1.386	0.734
9	Pinyon-juniper (south slope)	0.689	0.595	0.063	1.386	0.497
10	Pinyon-juniper (north slope)	0.000	-	-	-	-
11	Sagebrush	0.000	-	-	-	-
12	Mixed brush	0.349	0.342	0.006	0.693	0.503
13	Douglas fir	1.131	1.114	0.004	1.386	0.815
14	Aspen	1.315	1.294	0.004	1.792	0.734
15	Riparian	1.760	1.744	0.002	2.773	0.635

\- Insufficient data for computation

Table 3-7-250 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all avifauna transects during sample period 5, June 1975, for RBOSP

Transect Number	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	2.415	2.372	0.005	3.045	0.793
2	Sagebrush	1.249	1.211	0.006	1.386	0.901
3	Rabbitbrush	1.011	0.987	0.010	1.792	0.564
4	Pinyon-juniper/mixed brush	1.594	1.551	0.007	1.946	0.819
5	Mixed brush	1.157	1.121	0.011	1.609	0.719
6	Pinyon-juniper/sagebrush	2.042	2.011	0.003	2.398	0.851
7	Upland meadow	1.662	1.615	0.005	1.946	0.854
8	Greasewood-sagebrush	1.498	1.478	0.004	2.485	0.603
9	Pinyon-juniper (south slope)	2.084	2.041	0.004	2.485	0.839
10	Pinyon-juniper (north slope)	1.686	1.660	0.007	2.565	0.657
11	Sagebrush	1.351	1.320	0.006	1.946	0.691
12	Mixed brush	1.555	1.530	0.003	2.079	0.748
13	Douglas fir	2.470	2.449	0.001	2.565	0.963
14	Aspen	2.428	2.398	0.002	2.833	0.857
15	Riparian	1.921	1.909	0.002	2.944	0.652

Table 3-7-251 Shannon-Weiner diversity indices (H'), unbiased estimates of H' (E(H')), variance of H' (var (H')), maximum expected value of H' (H'(max)), and equitability (J) for all avifauna transects during sample period 6, October 1975, for RBOSP

Transect Number	Vegetation Type	H'	E(H')	var(H')	H'(max)	J
1	Bottomland meadow	1.192	1.127	0.011	1.386	0.860
2	Sagebrush	0.745	0.718	0.016	1.099	0.678
3	Rabbitbrush	1.648	1.628	0.004	2.079	0.793
4	Pinyon-juniper/mixed brush	1.538	1.477	0.011	1.946	0.790
5	Mixed brush	0.941	0.918	0.008	1.386	0.679
6	Pinyon-juniper/sagebrush	1.355	1.322	0.008	1.946	0.697
7	Upland meadow	0.000	0.000	0.000	0.000	-
8	Greasewood-sagebrush	1.789	1.756	0.005	2.303	0.777
9	Pinyon-juniper (south slope)	0.349	0.335	0.012	0.693	0.503
10	Pinyon-juniper (north slope)	0.654	0.637	0.007	1.792	0.365
11	Sagebrush	1.306	1.278	0.006	2.079	0.628
12	Mixed brush	0.100	0.095	0.003	0.693	0.144
13	Douglas fir	1.352	1.312	0.012	1.946	0.695
14	Aspen	1.145	1.108	0.014	1.609	0.712
15	Riparian	1.031	1.017	0.004	1.946	0.530

\- Insufficient data for computation

E. Winter Track Counts

1. Objectives - Once each winter, snow track counts are made to provide information on the distribution, relative abundance and habitat preference of big game, lagomorph, predator and small mammal species.

2. Methods

a. Data Collection - Transects 270 m (885.6 ft) in length are established along one line of stations of the small mammal live-trapping grids in each of the major vegetation types (Figure 3-7-27). Line A of the small grids (Figure 3-7-25) and line F of the larger grids (Figures 3-7-24 and 3-7-26) are used for this purpose. All existing tracks are obliterated from each transect at a known date and time, either by a new snowfall or by sweeping tracks from the transect, leaving a cleared path at least 1.2 m (4 ft) wide. No sooner than 22 hours after old tracks have been cleared are new tracks identified and the number of crossings of each track type counted and recorded, along with the date and time the transect is surveyed, on field data form (Figure 3-7-68). Not more than 50 hours will elapse after the old tracks are cleared. Ideally, track counts are made in this way at least twice during each sampling period, but only those transects surveyed on the same day are used for later interpretation. Transects are also discounted if wind and new snow interfere with accurate identification and counting of tracks.

b. Data Analysis - In order to compensate for different exposure times on different transects, an index of relative abundance was calculated by the following formula:

$$I = \frac{24T}{E}$$

where:

I = Index of relative abundance

T = Total number of tracks, each species, each transect

E = Number of hours of exposure, each transect

3. Data Summary - Winter track counts were made on eight transects in seven vegetation types between February 13 and February 21, 1975. Due to adverse weather conditions and inaccessible transect sites, certain days afforded incomplete results. The best results were obtained on February 16 and 19, when all eight transects were surveyed and snow and wind did not interfere. Therefore, the data from these two days will be used exclusively for interpretation.

Tracks of at least seven animal species (several were identified only to genus). were identified on the eight transects on February 16 and 19. The results for each transect are summarized in Table 3-7-254, which combined the data from the two days. Indices of relative abundance for each transect are given in Table 3-7-255.

Mule deer tracks were encountered on four of the eight transects, with most occurring in a north-facing pinyon-juniper vegetation type. Cottontail tracks occurred on four transects and were most abundant in both greasewood-sage and south-facing pinyon-juniper. Only one chipmunk (*Eutamias* sp.) was recorded, that being in south-facing pinyon-juniper habitat. Mice and voles (*Peromyscus* sp., and *Microtus* sp.) occurred on four of the transects and in a variety of habitat types. Coyote (*Canis latrans*) tracks were recorded on four transects and were most abundant in the bottomland meadow. Two sets of bobcat (*Lynx rufus*) tracks were observed side by side in south-facing pinyon-juniper. Weasels (*Mustela* sp.) occurred in rabbitbrush and mixed brush vegetation types. The three transects above 7,200 ft (sagebrush, mixed brush, and upland meadow) had the lowest total numbers of track crossings.

The high track count of mule deer on Transect C would seem to indicate a preference for pinyon-juniper; however, none were encountered on Transect B, also pinyon-juniper. This extreme difference between track occurrences may be explained by differences between the two sites. Transect B is on a steep, south-facing slope while Transect C is on a more gentle, north-facing slope. Near Transect B (~150 m) and running parallel to it was a heavily used road, while the road near Transect C was unplowed.

4. Discussion

Track count data show the greatest number of tracks were left by mule deer, cottontails and coyotes. Direct comparison of the numbers of tracks left by one species in comparison to those left by a different species may not yield valid conclusions about the relative abundance of the two. Track counts may be more accurately termed "use indices" since they are best used to indicate relative use of the different vegetation types by each species.

Adjusted track counts shown in Table 3-7-255 suggest that during the sample period mule deer favored the pinyon-juniper (north slope) vegetation type by a wide margin over all other types. Rabbitbrush, a bottomland site adjacent to pinyon-juniper (north slope), showed the second highest number of track crossings, a possible indication of nighttime foraging on bottomland shrubs.

The predominance of cottontail tracks on the pinyon-juniper (south slope) and greasewood/sagebrush transects, despite low coyote tracks, may be an indication that coyotes find bottomland hunting more successful or that the single transect in each type sampled too small an area for too short a time to record the movements of wider-ranging animals such as coyotes.

The high adjusted track counts for coyotes in bottomland meadow indicated that prey abundance in that type, even though largely under the snow, has attracted coyotes to hunt the meadow extensively. Similarly, the high track count index for mule deer in north slope pinyon-juniper reflects their probable use of this stand for shelter during the sample period.

Comparisons between species in a given vegetation type are complicated by species' differences in behavior and foraging patterns. Mice and, especially, voles may travel under the snow surface, while the larger mammals must leave visible tracks if they move through an area. In addition, the larger mammals such as deer and coyotes might be expected to range farther than mice, voles, and cottontails which have a much more restricted range. Thus, the smaller species might be expected to cross a given track count transect more fre-

quently during their normal foraging within more restricted areas. An exception to this might be the short cycle, zig-zag hunting patterns of a coyote. December 1974 small mammal live-trapping data showing abundant mouse and vole populations in the bottomland meadow support the possibility that hunting coyotes accounted for the large number of coyote tracks recorded at that site.

Figure and Tables for the
Winter Track Counts Section

WINTER TRACK COUNT FIELD DATA SHEET

Date/Time__________ Transect Name/Number__________

Snow Condition__________

Date/Time of Last Snow or Erasure__________ Project__________ Observer__________

Species	Number of Crossings	Total Number of Crossings	Additional Notes*

*Track pattern, measurements, etc.

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Figure 3-7-68. Winter track count field data sheet for RBOSP

Table 3-7- 254

TOTAL NUMBER OF TRACK CROSSINGS OF EACH SPECIES OBSERVED ON WINTER TRACK COUNT TRANSECTS FOR RBOSP, FEBRUARY 16 AND 19, 1975

	Vegetation Type/Transect Number								
Species	Pinyon-Juniper South Slope B	Pinyon-Juniper North Slope C	Bottom-land Meadow 1	Rabbit-Brush 3	Greasewood/ Sagebrush A	Sage-Brush D	Mixed Brush 5	Upland Meadow 7	Totals
Mule deer (_Odocoileus hemionus_)	0	149	0	19	0	3	1	0	172
Cottontail (_Sylvilagus_ sp.)	15	2	0	2	21	0	0	0	40
Chipmunk (_Eutamias_ sp.)	1	0	0	0	0	0	0	0	1
Mouse, Vole (_Peromyscus_ sp. _Microtus_ sp.)	4	0	4	9	0	0	0	2	19
Coyote (_Canis latrans_)	0	0	30	1	1	0	0	4	36
Bobcat (_Lynx rufus_)	2	0	0	0	0	0	0	0	2
Weasel (_Mustela_ sp.)	0	0	0	2	0	0	1	0	3
TOTALS	22	151	34	33	22	3	2	6	273
Total number of hours each transect was exposed for tracks (two counts)	88.5	76.5	74.0	75.0	75.0	96.5	76.5	99.5	

Table 3-7-255

RELATIVE NUMBER OF TRACK CROSSINGS * OBTAINED FROM WINTER TRACK COUNTS FOR EACH SPECIES ON EACH TRANSECT, FOR RBOSP, FEBRUARY 16 AND 19, 1975

Species	Pinyon-Juniper South Slope B	Pinyon-Juniper North Slope C	Bottom-land Meadow 1	Rabbit-brush 3	Greasewood/ Sagebrush A	Sage-brush D	Mixed Brush 5	Upland Meadow 7	Totals
	Vegetation Type/Transect Number								
Mule deer (*Odocoileus hemionus*)	0.00	46.75	0.00	6.08	0.00	0.74	0.32	0.00	53.89
Cottontail (*Sylvilagus* sp.)	4.07	0.62	0.00	0.64	6.72	0.00	0.00	0.00	12.05
Chipmunk (*Eutamias* sp.)	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
Mouse, Vole (*Peromyscus* sp. *Microtus* sp.)	1.08	0.00	1.28	2.88	0.00	0.00	0.00	0.48	5.72
Coyote (*Canis latrans*)	0.00	0.00	9.72	0.32	0.32	0.00	0.00	0.86	11.22
Bobcat (*Lynx rufus*)	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54
Weasel (*Mustela* sp.)	0.00	0.00	0.00	0.64	0.00	0.00	0.32	0.00	0.96
TOTALS	5.96	47.37	11.00	10.56	7.04	0.74	0.64	1.34	84.65
Total number of species	4	2	2	5	2	1	2	2	7

*Corrected to 24 hr exposure time (see b. Data Analysis)

F. Reptiles and Amphibians

1. Objectives - The purpose of the reptile and amphibian sampling program is to determine habitat preference, distribution and, when possible, abundance of species of reptiles and amphibians occurring on and near Tract C-a.

2. Methods - Line transect methods are employed to sample reptiles and amphibians in all major habitat types on and near Tract C-a. Ten transects, each approximately 1,000 m (3,820 ft) in length, are surveyed once during June and August 1975 and 1976 by two observers walking far enough apart to preclude duplicate observations. Five transects are permanently located, one in each of the five major vegetation types (pinyon-juniper on north and south-facing slopes, sagebrush, greasewood/sagebrush, and mixed brush). Non-permanent transects are relocated during each sampling period to ensure that all vegetation types are sampled at least once during the two-year period. Species, numbers, microhabitat type, sex and age class (when possible), various environmental parameters and other data are recorded on a standard field data sheet (Figure 3-7-69).

Information regarding nocturnally active amphibian species is gathered opportunistically by ECI field personnel. Two nights during May and June 1975 and 1976 are devoted to sampling potential amphibian breeding sites (ponds) on and near Tract C-a. Species, numbers, habitat description, and sex and age class are recorded on a standard field data sheet (Figure 3-7-70).

The first individual of each species encountered in the area is killed by an injection of phenobarbital and prepared as a voucher specimen.

3. Data Summary - The reptile and amphibian species encountered during all investigations to date are listed in Table 3-7-256.

a. Line Transects - Herpetofauna line transect surveys were conducted twice during the past year (June and August 1975). Five permanent transects located within the major vegetation types were flagged and surveyed during both sampling periods. In addition to these permanently located transects,

non-permanent transects located within selected habitats were surveyed during each sampling period. Thus, data were collected from 15 locations, with 5 of these locations being sampled twice. All sampling locations are shown in Figure 3-7-71.

Results (the number of individuals of each species encountered during each transect survey) are given in Table 3-7-257. Because of equal sampling intensities at each location (two observers walking 1,000 m), results for each sampling site are directly comparable. It is important to note that adjustments were not made in the results to compensate for existing differences in relative detectability of lizards at different locations. Therefore, abundances indicated in open areas (pinyon-juniper) may be disproportionately higher than was indicated for areas with heavy underbrush (e.g., mixed brush), because lizards are easier to detect in open areas.

During both sampling periods, a total of five reptile species was encountered on 9 out of 20 transect surveys. These five species were recorded at six different locations within three major vegetation types (pinyon-juniper, sagebrush, and riparian) at elevations ranging from 6,300 to 7,300 ft, and with varying slope aspects. Reptiles were not recorded on the remaining 11 transect surveys. The vegetation types surveyed in which reptiles were not observed included mixed brush (three surveys at elevations from 7,300 ft to 7,600 ft and on southeast and north-facing slopes), greasewood/sagebrush (one survey at an elevation of 6,400 ft and flat), bottomland meadow (one survey at an elevation of 6,300 ft and flat), rabbitbrush (one survey at an elevation of 6,700 ft and flat), shadscale (one survey at an elevation of 6,400 ft and on a south-facing slope), and upland meadow (one survey at an elevation of 8,000 ft and flat).

The greatest abundance of reptiles was observed on transects located in pinyon-juniper; 57 of the total 61 reptile encounters were recorded on transects in this vegetation type. The greatest diversity of reptile species was observed on a transect in the pinyon-juniper/sagebrush vegetation type (elevation 6,300 ft; slope-south-facing), where there were steep sandstone outcroppings (Transect 6-NP).

The most frequently encountered species on the herpetofauna transects (50 out of 61 total encounters) was the sagebrush lizard (Sceloperus graciosus). This is one of the widest ranging and most abundant lizard species in North America (Tinkle, 1973) and is known to be mostly ground-dwelling, occurring in open areas with scattered bushes (Stebbins, 1966). In the study area, the pinyon-juniper vegetation type seems to provide the preferred habitat of the sagebrush lizard, with open ground as well as scattered brushes and deadfall under which these lizards seek shelter. Sagebrush lizards were recorded on all but one of the seven surveys within pinyon-juniper stands. Abundance of this lizard species was greatest on Transect 6-NP where there were steep sandstone outcroppings as well as bushes and deadfall (Table 3-7-257).

The short-horned lizard (Phrynosoma douglassi) is a wide-ranging ground-dwelling lizard that inhabits a variety of habitat types in western North America (Stebbins, 1954). This species was frequently encountered in the study area but nowhere appeared as abundant as the sagebrush lizard. Four short-horned lizards were recorded during three transect surveys in two vegetation types: pinyon-juniper (6,900 ft/north-facing slope) and sagebrush (7,300 ft/northwest-facing slope). Opportunistic sighting records have documented the presence of this species in mixed brush and upland meadow habitats as well. The short-horned lizard has also been observed on Cathedral Bluffs at an elevation of 8,400 ft.

Two eastern fence lizards (Sceloperus undulatus) and four tree lizards (Urosaurus ornatus) were recorded along Transect 6-NP surveyed in the pinyon-juniper vegetation type beneath steep south-facing sandstone outcroppings. The eastern fence lizard is similar in appearance to the sagebrush lizard with which it may coexist, but it remains ecologically distinct in its microhabitat selection, foraging strategies and diet preferences. The eastern fence lizard is more often found perched on elevated structures such as rocks than is the predominantly ground-dwelling sagebrush lizard (Turner, 1974). The tree lizard climbs more frequently than either of the two Sceloperus species. Neither the tree lizard nor the eastern fence lizard were commonly observed within the study area.

The only snake species encountered in the study area during the past year was the western terrestrial garter snake (Thamnophis elegans). This species occurs

in a wide variety of habitats, ranging from damp environments near water to dry areas far from water (Stebbins, 1966). The subspecies which occurs in the study area is commonly found in mesic environments near streams and ponds (Stebbins, 1954). During herpetofauna transect surveys, the western terrestrial garter snake was observed only once. This sighting was in August on a transect paralleling a perennial stream into which the snake retreated when approached. Opportunistic sightings (five to date) have documented this snake species in upland sagebrush far from water, as well as in bottomland habitats where there is nearby standing or running water. It is not a species that is commonly observed in the study area.

b. Amphibian Breeding Sites - Potential amphibian breeding sites were visited on two nights in May and on two nights in June 1975. Three amphibian species were observed or heard calling at two locations: Stake Springs pond and a small impoundment in Corral Gulch. These locations are shown in Figure 3-7-71.

The chorus frog (Pseudacris triseriata) is a small but vociferous frog that is commonly found during the breeding season in the vegetation beside shallow ponds and slow moving streams. This species was encountered at both impoundments surveyed, but no more than five individuals were ever heard calling at one time on any of the nights when the ponds were visited. A few Great Basin spadefoots (Scaphiopus intermontanus) were heard calling one night in May at the Stake Springs pond. This toad-like anuran is well adapted to arid regions, where it burrows into the ground during dry weather and emerges to breed in permanent or semi-permanent water following spring and summer rains (Stebbins, 1966). The tiger salamander (Ambystoma tigrinum) was observed both months in the Stake Springs pond, most often in its larval, rather than adult, stage. The tiger salamander is also a species that is tolerant to the stressful conditions of arid as well as cold regions, and may or may not remain in the larval stage to breed.

4. Discussion - Five reptile species were encountered on 20 herpetofauna line transect surveys conducted during June and August 1975. The sagebrush lizard appears to be the most abundant reptile species in the study area; 50

of these lizards were observed or captured on six surveys at four different locations. The other reptile species encountered, but in fewer numbers were the eastern fence lizard, tree lizard, short-horned lizard and western terrestrial garter snake. Greatest abundances of lizards were observed on transects within the pinyon-juniper vegetation type.

High species diversity is characterized by a large number of species occurring in a given area in approximately equal numbers (Pianka, 1967). In the Piceance Basin in general, and in Tract C-a study areas in particular, the diversity of reptile species appears low in comparison to that observed in surrounding areas (Thorne Ecological Institute, 1973 and Smith, Maslin, and Brown, 1965). This may be because the spatial heterogeneity (microhabitat diversity), an important factor in determining lizard species diversity (Pianka, 1967), is low in the area. The microhabitat diversity appeared high on Transect 6-NP where there were abundant high rock crevices as well as low-lying bushes and deadfall. Correspondingly, there was the greatest abundance (22 encounters) and diversity (three species) of lizard species at this site in comparison to other surveys wherein there were no encounters (12 surveys), encounters with only one species (six surveys) or encounters with only two species (one survey). Habitats such as that found at Transect 6-NP are rare in the study area.

Three amphibian species, the chorus frog, Great Basin spadefoot, and tiger salamander were encountered at two breeding ponds during May and June 1975. Tract C-a study area appears to have very few habitats suitable to breeding populations of amphibians, and abundance and species diversity for this group appears low in the few places where amphibians do occur. This is probably due in part to the temperature extremes and arid conditions of the area.

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Figures and Tables for the

Reptiles and Amphibians Section

HERPETOFAUNA TRANSECT FIELD DATA SHEET

Transect #_____ Vegetation Type______________________ Location______________________

Date__________ Time, Ground Temp. at Start__________ Time, Ground Temp. at End__________

Cloud Cover (%)__________ Wind Speed__________ Observer(s)__________ Project__________

Species	Approximate Perpendicular Distance From Transect	Microhabitat Type	Sex	Age Class	Additional Observations*

*Reproductive condition, broken tail, etc.

076/060175

ecology consultants, inc.

Figure 3-7-69

HERPETOFAUNA TRANSECT FIELD DATA SHEET FOR RBOSP

AMPHIBIAN COLLECTION SHEET

Project #:__________

Date	No.	Species	Sex	Age Class	Capture Location	Habitat Description	Collec-tor	Additional Notes *

*Reproductive condition, stomach contents, tail loss, etc.

075/060175

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Figure 3-7-70

AMPHIBIAN COLLECTION FIELD DATA SHEET FOR RBOSP

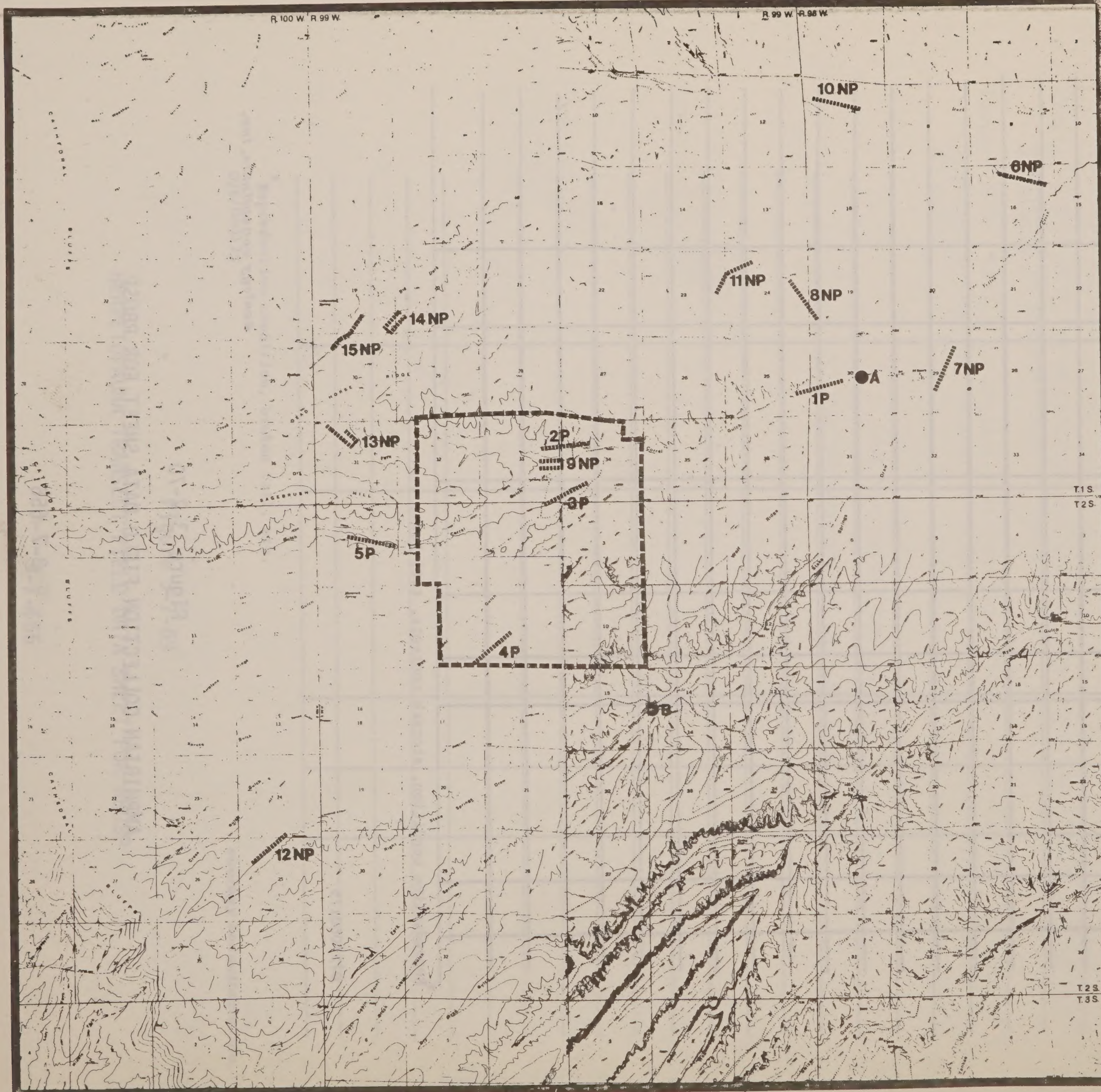

Figure 3-7-71

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

HERPETOFAUNA

SAMPLING LOCATIONS

JUNE-AUGUST, 1975

LINE TRANSECTS
P PERMANENT
NP NON-PERMANENT

AMPHIBIAN BREEDING SITES
A CORRAL GULCH IMPOUNDMENT
B STAKE SPRINGS IMPOUNDMENT

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

Table 3-7- 256

SPECIES OF AMPHIBIANS AND REPTILES ENCOUNTERED TO DATE IN THE VICINITY OF TRACT C-a FOR RBOSP*

CLASS FAMILY Species	Common Name
AMPHIBIA	
AMBYSTOMIDAE	
Ambystoma tigrinum	Tiger salamander
PELOBATIDAE	
Scaphiopus intermontanus	Great Basin spadefoot
HYLIDAE	
Pseudacris triseriata	Chorus frog
REPTILIA	
IGUANIDAE	
Sceloperus undulatus	Eastern fence lizard
Sceloperus graciosus	Sagebrush lizard
Urosaurus ornatus	Tree lizard
Phrynosoma douglassi	Short-horned lizard
COLUBRIDAE	
Thamnophis elegans	Western terrestrial garter snake

*The following authority was used for amphibian and reptile nomenclature:

Stebbins, R.C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston. 279 pages.

Table 3-7-257

HERPETOFAUNA TRANSECT RESULTS FROM DATA COLLECTED DURING JUNE AND AUGUST, 1975 FOR RBOSP

Transect Number	Sampling Month (1975)	Vegetation Type (Slope Aspect/Elevation)	Sceloperus graciosus	Sceloperus undulatus	Urosaurus ornatus	Phrynosoma douglassi	Thamnophis elegans
1-P	June	Greasewood/Sagebrush (Flat/6400 ft)	0	0	0	0	0
1-P	August	Greasewood/Sagebrush (Flat/6400 ft)	0	0	0	0	0
2-P	June	Pinyon-Juniper (South/6900 ft)	9	0	0	0	0
2-P	August	Pinyon-Juniper (South/6900 ft)	9	0	0	0	0
3-P	June	Pinyon-Juniper (North/6900 ft)	3	0	0	1	0
3-P	August	Pinyon-Juniper (North/6900 ft)	7	0	0	0	0
4-P	June	Upland Sagebrush (Northwest/7300 ft)	0	0	0	1	0
4-P	August	Upland Sagebrush (Northwest/7300 ft)	0	0	0	2	0
5-P	June	Mixed Brush (North/7300 ft)	0	0	0	0	0
5-P	August	Mixed Brush (North/7300 ft)	0	0	0	0	0
6-NP	June	Pinyon-Juniper/Sagebrush (South/6300 ft)	16	2	4	0	0

Table 3-7-257

(CONTINUED)

Transect Number	Sampling Month (1975)	Vegetation Type (Slope Aspect/Elevation)	Sceloperus graciosus	Sceloperus undulatus	Urosaurus ornatus	Phrynosoma douglassi	Thamnophis elegans
7-NP	June	Bottomland Meadow (Flat/6300 ft)	0	0	0	0	0
8-NP	June	Upland Sagebrush (Flat/6600 ft)	0	0	0	0	0
9-NP	June	Rabbitbrush (Flat/6700 ft)	0	0	0	0	0
10-NP	June	Shadscale/Sagebrush (South/6400 ft)	0	0	0	0	0
11-NP	August	Pinyon-Juniper/Sagebrush (Flat/6600 ft)	6	0	0	0	0
12-NP	August	Upland Meadow (Flat/8000 ft)	0	0	0	0	0
13-NP	August	Mixed Brush (Southeast/7600 ft)	0	0	0	0	0
14-NP	August	Pinyon-Juniper/Mixed Brush (North/7200 ft)	0	0	0	0	0
15-NP	August	Riparian (Flat/7000 ft)	0	0	0	0	1
TOTALS			50	2	4	4	1

G. Invertebrates

1. Objectives - The objectives of the terrestrial invertebrate investigations are to collect and identify the abundant invertebrates associated with the major vegetation types, and to qualitatively and quantitatively describe the invertebrates whose hosts are made up of the dominant plant species within these habitats. Data serve as a basis for determination of the role of invertebrates in the ecosystem and a basis for future comparative studies on Tract C-a and the surrounding area.

2. Methods

a. Data Collection - Field sampling is scheduled at five sites during May, July, and September of 1975 and 1976. The sampling sites were selected so as to concentrate on the major vegetation types found in the area and are located near small mammal grids A, B, C, D, and 5 (Figure 3-7-27). These five sites are (1) greasewood-sagebrush, (2) south-facing pinyon-juniper, (3) north-facing pinyon-juniper, (4) upland sagebrush, and (5) mixed brush.

Various field sampling techniques are employed to capture invertebrates in different microhabitats at each sampling station, including pitfall, Malaise trap, sweeping, beating, litter D-Vac, and trap D-Vac sampling systems.

Ground-dwelling active species are captured and their abundance estimated using a pitfall grid at each sample site (Gist and Crossley, 1973). Pitfall captures depend on the movement of ground-dwelling invertebrates within the grid; thus, the fauna of importance in this method consist of those groups which do not fly or hop and are essentially confined to the ground. An area 10 (32.8 ft) x 10m was completely enclosed with aluminum border fencing sunk to a depth of 2 inches in the soil, leaving a 4-inch barrier above-ground to prevent movement in or out of the area by ground-crawling species. Twenty-five pitfalls, each consisting of a 0.35 l (12 oz) can with both ends removed, were spaced as evenly as possible within the enclosure. Each can was placed in the ground with the top rim just below the ground surface. A cup and a funnel were set

inside every can so that the lip of the funnel was at ground level and its stem led into the cup (Figure 3-7-72).

All pitfall traps are checked daily for 10 days during each sampling period. Specimens from each grid are combined into one sample, labeled, and placed in a standard 70% alcohol-3% glycerin solution daily. Samples are logged into a record book as collected and routed to ECI laboratories for identification and enumeration.

One Malaise trap as described by Townes (1972) was placed at each of the five sampling sites to capture mobile airborne species. The trap consists of a tent made of dacron netting (25 meshes/inch) which is open on two sides and divided in the middle (Figure 3-7-73).

Invertebrates which fly into the trap hit the screen dividing the trap and begin to crawl upward along the screen to the highest point of the tent where they enter a jar containing a standard alcohol-glycerin solution. A wire fence consisting of four 4.5-ft posts and two strands of No. 9 gauge wire was put up around each trap to prevent interference from ungulates.

The trap is designed for flying groups such as Diptera and Hymenoptera, which exhibit a characteristic upward crawling movement when trapped. Other groups such as Homoptera, Hemiptera, and Coleoptera often drop off the screen and escape by crawling or hopping out. The Malaise traps are opened on the first day of sampling and checked daily, with the insects being removed two to three times during the sampling period of about 10 days. Samples are labeled and logged into the record book and transported to the laboratory for identification and enumeration.

Sweep samples are taken from the herbaceous stratum at each site as well as from tall shrubs and trees at Sites 1, 2, and 3. Sweeps are taken with a standard net having a bag 76 cm long and an opening 38 cm in diameter. Because the vegetation types are such that a regular sweep transect, where the collector makes regular 180° back and forth motions, cannot be made, a sweep is considered to be one motion across the plant or plants sampled with 100 of these motions

making up the sample from each site. Tall shrub and tree samples are taken in the same manner with 50 sweeps each from pinyon pine (Pinus edulis) and juniper (Juniperus osteosperma) at Sites 2 and 3 and 50 sweeps from sagebrush (Artemisia tridentata) at Site 1. The purpose of the sweep samples is to provide qualitative data on invertebrates in herbaceous and tall tree and shrub strata not being specifically sampled by other techniques. In the herbaceous stratum, the samples reveal invertebrates associated with plant species not being specifically sampled by the trap D-Vac method. In the tall shrub and tree sampling, sweeping and beating provide a sample of the invertebrates not sampled with other proposed methods. The upper portions of these plant specimens may contain invertebrates which, when disturbed, fly or cling to the vegetation; these are picked up by the sweep net. All sweep samples are labeled and placed in alcohol, logged in the field log book, and transported to the laboratory for analysis.

Invertebrates which inhabit the tall shrubs and trees may also drop to the ground when disturbed. These are sampled using a beating cloth which is a circular canvas spread under the plant. Vigorous shaking and beating of the plant causes the invertebrates on the vegetation to fall to the canvas after which the resulting litter is removed and transported to the field office and placed in a Berlese funnel.

Two beating samples are taken from big sagebrush at Site 1 and two each from pinyon and juniper at Sites 2 and 3 during each sampling period.

Ground litter is quantitatively sampled for invertebrates with a commercial vacuuming unit and an open cylinder. The cylinder is placed on the surface and all litter and loose soil is vacuumed from the area inside. The sample is then placed in a muslin bag, labeled, recorded in a log book, and transported to the field laboratory for Berlese teratement. After Berlese extraction for 60 hours, the litter is weighed. One of the five samples taken from each site is placed in a standard alcohol-glycerin solution (after Berlese treatment and weighing) and is transported back to the ECI laboratory. This sample is hand-picked to determine numbers of invertebrates present after Berlese extraction. Efficiency is read as a percentage equalling the number of invertebrates collected

in Berlese treatment divided by the number collected in Berlese treatment plus the number found in hand-picking the remains. This calibration is performed only during the first and last sampling periods of each year.

Invertebrate species found in association with dominant shrub species at each sample site are sampled using a trap and a commercial vacuuming unit. The trap consists of a square metal frame covered with No. 60 mesh screen and enclosing an area of 0.5 m^2 (5.4 sq ft) which is placed over the plant to be sampled. The trap prevents escape of the invertebrates. Invertebrates are removed from the trap by suction. After the area has been vacuumed thoroughly with the trap in place, the trap is removed and the vacuuming repeated. The second vacuuming allows the operator to get down close to the plant, insuring a more complete removal of invertebrates and litter. Samples are left in D-Vac bags and transported to the field station for Berlese extraction. During vacuuming, the plant is visualized as a sphere and the diameter estimated to get a measure of numbers per plant volume. The efficiency of removal by vacuuming is calibrated by clipping the plant and placing it in a plastic bag immediately after the second vacuuming. The plant is taken to the field station or laboratory for inspection of remaining invertebrates. Immediately following clipping, another brief vacuuming is made of the clipped area; this material is also hand-sorted. The efficiency calibration, which consists of the number of invertebrates after Berlese treatment divided by the number after treatment plus the number left on the plant, is done for one specimen of each plant species sampled at each site in May and September. Plants from each species designated for sampling are selected in the field primarily on the basis of workable size for using the trap. During each sampling period, five trap samples are taken from one or more dominant shrubs at each sampling site as follows:

- Site 1 - rabbitbrush (*Chrysothamnus nauseosus*)
- Site 2 - shadscale (*Atriplex confertifolia*)
- Site 3 - sagebrush (*Artemisia tridentata*)
- Site 4 - sagebrush (*Artemisia tridentata*)
- Site 5 - serviceberry (*Amelanchier utahensis*)
  snowberry (*Symphoricarpos oreophilus*)

All samples are placed in Berlese funnels for separation on the same day they are taken. Calibration of Berlese and vacuuming efficiencies occurs only

during the first and last sampling period each year. Hand-picking of Berlese remains is done for one specimen of each plant species sampled at each site. Each Berlese funnel consists of a sheet metal cylinder 40.6 cm long and 35.5 cm in diameter, with a cone of equal diameter and 25.4 cm long attached to the lower end. A jar lid is attached to an opening at the apex of the cone to which sample collection jars partially filled with a 30% alcohol solution are attached. Samples are placed on two grids set inside the cylinder. The remaining open end of the cylinder is covered with a cone 5.2 cm high containing a light bulb socket (Figure 3-7-74). The sample is placed in the refrigerator prior to being put in the Berlese to decrease invertebrate activity. It is then dumped onto the grid in the cylinder; the top cone, containing an illuminated 60 watt bulb, is then placed over the cylinder. The heat from the bulb causes the debris to become hot and dry, whereupon most invertebrates tend to move downward to escape, eventually falling into the Berlese preservative.

All samples taken in the field and transported to the laboratory for analysis are handled in the same way -- placed in a container of 70% alcohol-3% glycerin, labeled, recorded in the field log book, transported to the laboratory and receipted upon arrival in the laboratory.

b. Data Analysis

1) Enumeration

a) Pitfall Trapping - The capture per unit effort method (Southwood, 1968; Gist and Crossley, 1973) is used to provide density estimates for ground-dwelling invertebrates captured in pitfall traps during each 10-day sampling period. This method utilizes the principle of diminishing returns in that a decrease in number captured per unit effort is usually noted toward the conclusion of a series of successive samples. If the rate of decrease in captures per unit effort is reasonably constant, it can be measured and used to estimate the total population size.

The decrease in catch per unit effort is shown by graphing catch per unit effort against cumulative catch. From the graph thus produced, it can be

observed that if a line through the plotted points is extended until it strikes the x-axis (where catch per unit effort is zero), an estimate of the total population size is obtained.

The most accurate method for projecting the line is by use of the least squares method of linear regression (Snedecor and Cochran, 1967). The equation for the straight line through the plotted points is:

$$y = a + bx$$

where: a = point of intercept on y-axis
b = slope of line
x = cumulative catch
y = catch per unit effort (i.e., catch per day)

The unknowns, a and b, for the least squares line may be determined by the following formulas:

$$a = \bar{y}\ b\bar{x}$$

$$b = \frac{\Sigma xy - \frac{\Sigma x\ \Sigma y}{n}}{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}$$

where: n = number of y value
$\bar{y}$ = mean of catch per unit effort values
$\bar{x}$ = mean of cumulative catch value

An estimate of the total population size can then be determined from:

$$\text{population size} = -(a/b)$$

It is obvious in the above formula that if the slope (b) of the line is not negative (i.e., the rate of decrease in captures per unit effort is not reasonably constant), a reliable population density estimate is not possible.

b) Litter - Invertebrates per kilogram of litter were calculated using the total captures in a sample (n), calibration factors found through hand sorting (c), and the dry weight of the litter sampled (kg): nc/kg.

c) <u>Malaise Trap</u> - Malaise traps are designed to capture mobile, airborne groups which escape other methods. Results are discussed in terms of the fauna at each site, and relative between-site quantitative comparisons.

Preliminary examination of sample size suggested that identification and enumeration of the entire sample would likely overrun the available time. Time needed for completion of one-sixteenth parts confirmed the preliminary observations and a subsampling program was initiated. It was felt that a minimum total of 100 invertebrates in one or more one-sixteenth subsamples would be adequate, with more subsample results added to these totals if the schedule permitted. Estimated total density was determined by multiplying the actual total by the reciprocal of the total subsample size used.

d) <u>Trap D-Vac Sampling</u> - Samples taken using a trap and a vacuuming unit were designed to quantify invertebrates per cubic meter of space occupied by a known plant species.

Analyses of data include number of insects per volume of shrub species per unit of area in each vegetation type sampled. Shrub volume data gathered during both the invertebrate and phytosociological studies are used to calculate the average volume of the dominant shrubs in each of the three vegetation types subjected to invertebrate sampling.

Two factors appear to be of primary importance in calculations of numbers of invertebrates per cubic meter of plant. The first is the absence of correlation between number of invertebrates captured and the size of the shrub. The basic assumption that leaf and stem surface are correlated to the plant volume is false, and consequently, comparisons of fauna of different volume shrubs may not necessarily be valid. Two shrubs of different volume may have the same leaf surface available for feeding. Differences in the appearance of the shrub based on the amount of leaf surface and the volume may also have variable effects on insects searching for vegetative food sources.

The second factor which has a direct result on the estimate of numbers of invertebrates per cubic meter is the use of calibration factors. A D-Vac

calibration factor is applied to compensate for the percentage of invertebrates which escape vacuuming, with the assumption that the percentage of the total invertebrates remaining after vacuuming should be about the same for all samples. This assumption is based on results which show that most of the species remaining on the plant site after vacuuming are also present in the vacuumed sample, indicating a lack of complete efficiency of removal which is probably true for all specimens of the same plant species sampled. In most cases, vacuuming efficiency was 100% or near 100%.

A different problem presents itself with application of a berlese calibration factor. Some groups do not lend themselves to separation by berlese, but remain and die in the litter. The number of invertebrates remaining can be presented as a percentage of the total insects to give an efficiency of extraction for that plant species. The application of a multiplier to all samples to account for this less-than-100% efficiency in the test sample is based on the assumption that the invertebrates in each sample are basically the same and react the same in the berlese funnel.

2) Feeding Habits - All invertebrate families captured have been categorized into feeding types (Table 3-7-258). Within each order there are many families for which food type and feeding type are well-known, and these feeding type categories often apply to all members of the family. For others, however, nothing is known about feeding, or food habits are diverse within the family. In the latter case, the most prevalent feeding type was used for calculation purposes, and in the former, the family was included as an unknown. There are two exceptions to these criteria: ants (Formicidae) are extremely varied in their food selection, and many vary their diet seasonally or as a response to availability, therefore, members of the family Formicidae are considered omnivorous. In the case of mites (Acari), little taxonomic work was done beyond the order level, so they were considered unknowns.

Food habit percentages are obtained by dividing the number of invertebrates within each of the main categories (predator, herbivore or flower feeder, saprovore, omnivore, and unknown) by the total invertebrate numbers within the site and sampling type.

For purposes of assigning feeding habits to each family, the following classification system was developed.

- Plant sap feeder (Psf) - feeds on all plant juices except nectar
- Plant tissue feeder (Ptf) - feeds on all plant parts except pollen
- Seed feeder (Sf) - feeds largely on seeds at some stage of its life cycle
- Nectar feeder (Nf) - feeds on plant nectar
- Pollen feeder (Pf) - feeds on pollen at some stage of its life cycle
- Fungus feeder (Myp) - feeds on fungi
- Saprovore (S) - feeds on dead and decomposing plant and animal material
- Omnivore (O) - feeds on both plant and animal material
- Entomophagous predator (Epr) - feeds on insects and other arthropods
- Mammalian predator (Mp) - feeds largely on secretions around vertebrate eyes and sores, or under the skin of mammals
- Entomophagous parasite (Epa) - spends one or more life stages feeding upon and destroying only one insect

In determining percentages of food habits, categories 1-3 are considered herbivores, 4 and 5 flower feeders, and 9-11 predators.

A composite list of all invertebrate families captured and their feeding types is presented in Table 3-7-258.

3. Data Summary - Invertebrate samples were taken utilizing seven different techniques (pitfalls, litter D-Vac, trap D-Vac, herbaceous sweeps, beating, aerial sweeps and Malaise traps) in June, July, and September, 1975 at five sampling sites established in different vegetation types on or near Tract C-a. Invertebrate sampling locations are the same as several used for small mammal sampling and are described in Table 3-7-259. Table 3-7-260 represents a list of the invertebrate groups collected and identified to date. Species groups deemed important numerically or because of their feeding habits will be sent to recognized experts for confirmation of species identification.

a. <u>Greasewood-Sagebrush Habitat (Site 1)</u> - Density calculations are made for invertebrates captured in pitfalls at the greasewood-sagebrush site (Site 1) by plotting capture rate against total numbers removed.

To obtain this estimate, the capture rate must decrease over time during the sampling period. This criterion has not been met for many orders of invertebrates, however. In many cases the data trends show either large day-to-day population fluctuations, drastic declines or increases in populations, or little population fluctuation over the 10-day trapping period.

In June at the greasewood-sagebrush habitat the estimated density of ground dwellers was calculated at 4.13 invertebrates per m^2. Phalangida was the most abundant order with a relative abundance of 21.89% (Table 3-7-261). Hymenoptera and Coleoptera were the second and third most abundant orders captured, accounting for 36.48% of total invertebrates captured in the greasewood-sagebrush habitat in June. Density estimates for these groups could not be made because a gradual decline in their capture rate was not apparent. Results from feeding habit classification show saprovores to be the numerically dominant feeding type, although three other feeding types had over 10% of the total numbers captured (Table 3-7-262). Harvestmen (Phalangida) were the largest group of saprovores, although other saprovores consisted of Colembola and Thysanura. Predators, the second largest group at Site 1, were almost exclusively spiders (Araneida) and ground beetles (Coleoptera: Carabidae). Ants (Hymenoptera: Formicidae) were the only family included in the omnivore feeding group.

In July, invertebrates in 13 orders were taken. Densities were calculated for Orthoptera, Araneida, and Phalangida, which together contributed 16.33% of the total numbers captured. Of these, Orthoptera (density = $0.21/m^2$) had a relatively constant capture rate over the 10-day period, and Araneida (density = $6.55/m^2$) and Phalangida (density = $1.22/m^2$) fluctuated (Table 3-7-263). The capture rates of remaining abundant orders did not meet the assumptions of density estimation. Five of the feeding habit types contained greater than 11% of the total captures of the ground-dwelling fauna in the greasewood-sagebrush habitat (Table 3-7-264). Of these five, unknowns (primarily Acari) contained the largest total at 33.5% followed by saprovores (Phalangida, Collembola, and Psocoptera) at 28.0%.

In September, 741 invertebrates representing 11 orders were captured, giving an estimated density of 9.97 individuals per m^2 (Table 3-7-265). Daily captures for most orders generally fluctuated; however, numbers of spiders (Araneida) and beetles (Coleoptera) taken remained relatively constant. Mites (Acari) and ants (Hymenoptera: Formicidae), the two largest groups in total captures over the 10-day period, had the largest day-to-day fluctuations in captures.

The percentage of unknowns in the food habit categories reflects the percentage of Acari in the total captures from the greasewood-sagebrush habitat in September (Table 3-7-266). The second largest feeding category, omnivore, consisted entirely of ants, and the third, saprovore, consisted of Collembola, Psocoptera, and Phalangida. The last feeding category with over 10% of the total captures, predator, was made up primarily of spiders (Araneida), with some beetles (Coleoptera) and 1 centipede (Lithobiomorpha).

A comparison of pitfall results from all three sampling periods at the greasewood-sagebrush site shows the lowest total captures in June with 233 individuals, a peak of 1,409 in July, and 741 in September. Acari was by far the most numerous invertebrate order captured in July and September in greasewood-sagebrush, accounting for 32% of the total in July, and 44% in September. The most numerous insect group captured was ants (Hymenoptera, Formicidae), which were taken in relatively constant numbers during each sampling period. Over the summer, changes in percentages of total captures in each feeding category at the greasewood-sagebrush habitat varied considerably. Changes in the unknown feeding category are directly related to changes in Acari captures during the three sampling periods, and changes in omnivore percentages were based exclusively on captures of ants. In the saprovore level, changes in percentage of total captures are based on captures in a variety of orders, and as such are dependant on different numerically dominant orders in each period. In June, Phalangida was the numerically dominant saprovore, in July - Psocoptera, and September - Collembola.

In samples taken from the litter at the greasewood-sagebrush habitat (Site 1) in June, the number of invertebrates varied from 0 to 117.6 per kilogram of litter (Table 3-7-267) with an average of 38.0 invertebrates per kilogram of

litter and a standard error of 20.5 (Table 3-7-268). Variation in microhabitat partially accounts for the range of numbers per kilogram litter. Sample number 132 was taken in an open grassy area and contained no invertebrates, while number 133 was taken under a greasewood plant, and yielded the largest estimate of invertebrate numbers per kilogram litter (117.6). The remaining three samples were from under sage and varied from 18.2 to 30.3 invertebrates per kilogram litter. Numerically, predominant groups at the greasewood-sagebrush site were dictynid spiders (Dictynidae) and ground beetles (Carabidae), which contributed just less than half of the 56 total captures (Table 3-7-269). Eight winged ant reproductives were also captured.

Feeding habit results for the greasewood-sagebrush site in June show the predator level as the most abundant, due to the influence of spiders and ground beetles, the two most abundant groups captured (Table 3-7-270). The unknown category consisted mainly of mites. Herbivores, the third largest feeding category, consisted of a variety of families in the orders Thysanoptera, Hemiptera, Homoptera, Coleoptera, and Lepidoptera.

During July, the number of invertebrates per kilogram of litter at the greasewood-sagebrush site averaged 53.7 with a standard error of 13.6 (Table 3-7-271). Variation in sample results (Table 3-7-272) is again partially explained by microhabitat differences existing at the sample site. For example, sample number 220, which contained only 8.5 invertebrates per kilogram of litter, was taken in an open grassy area dominated by a rye grass (Elymus cinereus). Of the other four samples, numbers 219 and 222, with 84.6 and 49.3 invertebrates per kilogram litter, respectively, were taken under sagebrush (Artemisia tridentata) and samples 218 (46.8/kilogram) and 221 (79.3/kilogram) from under rabbitbrush (Chrysothamnus sp.). Eighty-five invertebrates in 17 species groups were taken in the litter samples. Thirty-three percent of these were mites (Acari) (Table 3-7-273).

The most numerous insect families taken in July litter samples were ground beetles (Carabidae) and ants (Formicidae), both of which showed a preference for sage or rabbitbrush litter (Table 3-7-273). Unknowns in theorders Hemiptera and Diptera, two orders not normally abundant in the litter, were captured in relatively large numbers in July litter samples. Of the 17 total species groups encountered, greater than 1/3 were beetles (Coleoptera).

The percentage of total captures in each feeding type is presented in Table 3-7-274. The unknown category is the largest with 62.4% of all invertebrates captured, including Acari, adult Diptera, and unknown Homoptera and Hemiptera. The omnivore level (11.8% of captures) consisted entirely of ants, and the predator level consisted of spiders and ground beetles (Carabidae).

In September, an average of 348 invertebrates was taken per kilogram of litter at the greasewood-sagebrush site with a standard error of 79.7 (Table 3-7-275). Sample results ranged from 129 to 578 invertebrates per kilogram of litter (Table 3-7-276). Sample number 333, which had the lowest total number of individuals (129.4), came from an area dominated by rye grass, while totals for the two samples taken under sagebrush contained 419.5 and 399.0 invertebrates per kilogram of litter. Of the 498 invertebrates taken in litter samples captured in the greasewood-sagebrush habitat in September, approximately 81% were booklice (Psocoptera) and mites (Acari), which contributed 44% and 37% of the totals, respectively (Table 3-7-277). Approximately three-quarters of the Psocoptera came from samples taken under rabbitbrush, while the remainder were fairly evenly distributed among the four remaining samples. The greasewood-sagebrush site was the only sampling location where Psocopterans occurred in high numbers. Sixty-three percent of Acari were taken under sage; the remaining 37% were evenly distributed among the three remaining samples. Diplura, a soft-bodied insect order characteristic of damp litter situations, were taken only at this site, and represented approximately 3% of the total individuals captured (Table 3-7-277). Of the 25 species groups encountered in the litter in September, more than one-third were beetles (Coleoptera). Results of percentage calculations of total captures in each feeding type in September at the greasewood-sagebrush site reflect the numerical dominance of Psocoptera and Acari. Two hundred and seventeen of the 233 saprovores were Psocopterans and most of the unknown feeding category was Acari (Table 3-7-278).

A comparison of results for Site 1 over the three sampling periods shows an increase in average numbers of invertebrates per kilogram of litter from 38.0 in June to 53.7 in July to 348.0 in September. This increase was demonstrated for all microhabitats sampled at this site. Actual captures from all five sites sampled in greasewood-sagebrush went from a total of 56 to 498 invertebrates. Mites (Acari), which were the numerically dominant group in July and

September litter samples, were absent from samples taken in June. Only one dictynid spider, the second largest group in June samples, was present in July and none were taken in September. Ground beetles (Carabidae), the most common insect family in June (16 individuals), decreased in July to 6 in September samples to one individual.

Psocoptera numbers peaked in September in the greasewood-sagebrush litter samples with 217 individuals (Table 3-7-277). Only five individuals were captured in July (Table 3-7-273) and none appeared in the June samples.

Only three insect species groups were found in both June and July samples at the greasewood-sagebrush site, although this does not include non-litter insect families, or non-insect invertebrates which were not identified below the family level. From July to September, only three groups were present.

Results of sweeping the ground layer vegetation of the greasewood-sagebrush habitat in June showed 127 specimens captured in 100 sweeps (Table 3-7-279). Of this total, over one-half of the invertebrates fell into three groups: thrips (Thysanoptera), leafhoppers (Cicadellidae), and ants (Formicidae). Site 1 is the only site where thrips and Collembola were collected in June and the only site where leafhoppers were found in large numbers (nearly one-fourth of the total invertebrate captures).

The greasewood-sagebrush site had the largest total herbaceous sweep captures in June, as well as the largest number of species. Herbivores made up 57% of the fauna captured in herbaceous sweeps at Site 1 (Table 3-7-280). Thrips and leafhoppers, the dominant groups in total captures, are the major contributors to this feeding category. Ants were the only omnivores sampled, and in the flower feeding level there were a variety of flies (Diptera) and wasps and bees (Hymenoptera) with no family or species group dominating the total captures in the feeding type.

Four hundred and nineteen invertebrates were taken in 100 sweeps at site 1 in July (Table 3-7-281). A variety of invertebrates made up the total, including 38 families and 66 species groups. Numerically dominant families were leafhoppers (Cicadellidae) and chloropid flies (Chloropidae), each with 27% of the

total numbers. Leafhoppers were important in terms of total numbers at all sites, but Site 1 is the only sampling area in which Chloropidae are an important part of the fauna. These two families also contained the largest number of species groups, however, the most diverse fauna occurred in the order Hymenoptera in which 56 individuals representing 22 species groups were captured. Of these 22 species groups, 17 were in families of wasps whose larvae are parasites of other invertebrates. One parasitic family, Eulophidae, contained 4% of the total captures. Other groups having a substantial percentage of total captures were Thysanura (8%) and Thysanoptera (5%).

Herbivores were the most abundant invertebrates captured in July (39.4% of total captures); many of these were leafhoppers and thrips (Thysanoptera). Hemiptera, Coleoptera, Lepidoptera, and one wasp family were also included in this category (Table 3-7-282). In the flower feeding category the majority of the captures were chloropid flies, adult parasitic wasps, and a few adult Diptera.

In September, 173 invertebrates representing 25 families and 38 species groups were captured in 100 sweeps at the greasewood-sagebrush habitat (Table 3-7-283). Sixty-one percent of all specimens taken were seed bugs (Lygaeidae); no other group represented more than 6% of the total sample. The abundance of seed bugs in the September herbaceous sweep captures is reflected in the large percentage (72.8%) of total captures which were herbivores; seed bugs alone contributed 61% of the total captures. Only one other feeding category contained more than 10% of the total captures, and these were flower feeders, primarily Hymenoptera and a few Diptera (Table 3-7-284).

Over the sampling season, total captures peaked in July at Site 1, with much smaller totals in June and September. This trend is also evident in the number of species groups sampled where the total of 66 in July is the most captured at any site all summer.

Cicadellidae, one of the most abundant families in June and July samples, was virtually absent from September samples, contributing less than 2% of the total

for that month. Thrips (Thysanoptera), the second most abundant group in June, were also present in relatively large numbers in July, but absent from September samples.

Chloropid flies, which totaled 27% of the July captures, were also present in June and September, but in each period the species groups were different.

Seed bugs (Lygaeidae) were the only abundant species in September at this site, and were present in June samples, although only one specimen was taken.

Of the 66 species groups present in July, 14 were also present in June, including four species of ants (Formicidae) and one species group of thrips (Thysanoptera). In September, only one species of beetle and one species of seed bug (Lygaeidae) were present which were also taken in June samples.

Herbivores were the most abundant invertebrates in herbaceous sweep samples during all sampling periods in the greasewood-sagebrush habitat.Abundant groups within this feeding type varied each period, with different species groups of leafhoppers dominant in June and July, and seed bugs the numerically dominant group in September. Flower feeders also contributed substantially to the total captures each period. The bulk of these were in a variety of dipteran and hymenopteran families. The increase in relative abundance of flower feeders in July is due to the large number of chloropid flies in addition to the above two orders.

Beating samples taken from tall sagebrush plants in the greasewood-sagebrush habitat in June contained 48 invertebrates in 20 species groups (Table 3-7-285). Four groups contained more than 10% of the total captures, with leafhoppers and mites most abundant, followed by aphids (Aphididae) and plant bugs (Miridae). The 20 species groups were relatively evenly distributed among the orders. The herbivore feeding type contained the largest number of captures at the greasewood-sagebrush site (Table 3-7-286).

Beating samples taken from the greasewood-sagebrush habitat in July revealed 777 invertebrates in 35 species groups (Table 3-7-287). Sixty-five percent of

the total numbers were contained in two families, plant bugs (Miridae) and leafhoppers (Cicadellidae). An additional 29% of the total was divided between thrips (Thysanoptera), aphids (Aphididae), and mites (Acari). The total of 777 invertebrates captured from sage is the largest total from beating samples at any site. The 35 species groups is also a high total for all sites, and included eight species groups of Miridae and five of Cicadellidae.

Miridae, Cicadellidae, Aphididae, and Thysanoptera were the most abundant herbivores taken in beating samples in July (Table 3-7-288). All are plant sap feeders.

In September, 173 invertebrates (15 species groups) were captured in beating samples from sagebrush (Table 3-7-289). Numerically dominant groups included aphids (Aphididae) and plant bugs (Miridae) which, combined, accounted for over 50% of the total captures. Thrips (Thysanoptera), leafhoppers (Cicadellidae), and mites (Acari) each provided greater than 12% of the total numbers.

Over the sampling season, the total invertebrates captured in beating samples at the greasewood-sagebrush site peaked in July as did the number of species groups. Of the 35 species groups present in July, five were also captured in June, although only mites (Acari) were considered numerically dominant in the early sampling period. That is, none of the abundant species groups of aphids, leafhoppers, or plant bugs present in June were present and abundant in July. September results showed five species groups which were also present in July. Of these, an aphid (Aphididae) species group was present and numerically dominant during both sampling periods. Species groups of Miridae and Cicadellidae which contributed substantially to their families' abundance in July were not collected in September.

Herbivores were the dominant feeding category present throughout the sampling season.

Aerial sweeps of sagebrush foliage taken in June at the greasewood-sagebrush habitat revealed 100 invertebrates in 18 species groups (Table 3-7-290). Plant bugs (Miridae) contributed 55% of this total, and 17% of the total were thrips

(Thysanoptera). All other families had less than 6% of the total captures. Of the 18 species groups recorded one-third were parasitic wasps in the order Hymenoptera.

Feeding habits for the invertebrates captured in aerial sweeps from sagebrush at the greasewood-sagebrush site in June show 78% herbivores, the bulk of which were Miridae and Thysanoptera (Table 3-7-291).

Aerial sweeps taken from sage in the greasewood-sagebrush habitat in July contained 300 invertebrates representing 43 species groups (Table 3-7-292). Numerically dominant families included leafhoppers (Cicadellidae) with 42% of the total captures and thrips (Thysanoptera) and plant bugs (Miridae) each with over 10% of the total captures. Of the 43 species groups recorded, nearly one-third were parasitic wasps.

The combined total captures of the three abundant families make up the bulk of the herbivore category in the sagebrush aerial sweep samples at the greasewood-sagebrush site (Table 3-7-293). Of the remaining 25.7% of the total captures not in the herbivore category, only predators contributed greater than 10%. This feeding type included minute pirate bugs (Anthocoridae), ladybird beetles (Coccinellidae), and crab spiders (Thomisidae) as the most abundant families.

In September, aerial sweeps from sagebrush in the greasewood-sagebrush habitat contained 172 invertebrates in 22 species groups (Table 3-7-294). Four species groups, Thysanoptera, Miridae, Cicadellidae, and Aphididae each contributed 15% or more of the total captures. Nearly one-half of the species groups taken were parasitic wasps in the order Hymenoptera. This group includes the family Platygasteridae, which was the fifth most numerous group with 16 individuals.

All of the groups with over 15% of the total captures made up the herbivore category, which totals 73.3% of the invertebrates taken (Table 3-7-295). Flower feeders, the second most abundant feeding type, consisted entirely of adult wasps.

Over the season, the total captures and number of species groups in aerial sweep samples from sagebrush in the greasewood-sagebrush habitat peaked in July. Thrips and plant bugs abundant in June were not taken in July samples. July and September samples had six species groups in common, including the dominant species group in each of the families of aphids (Aphididae) and leafhoppers (Cicadellidae) which was abundant in both sampling periods. Herbivores were the dominant feeding category during all sampling periods in aerial sweeps of sagebrush.

Results of 10 days of trapping invertebrates with a Malaise trap at the greasewood-sagebrush habitat (Site 1) in June yielded an estimated 5,206 invertebrates (Table 3-7-296). Upon completion of identifications for the first June Malaise trap sample it was determined that complete identification of all samples would be impossible due to time and budgetary constraints. A subsampling program was undertaken for the remainder of the samples, wherein each sample was divided into sixteen parts. After enough one-sixteenth subsamples from a site were identified to obtain a minimum of 100 individuals, identifications were stopped. An estimate of the total captured was then made by multiplying the subsample capture total by sixteen and dividing the resulting total by the number of one-sixteenth subsamples actually identified. In June, additional time allowed more complete identification of some samples, and the estimated totals were adjusted accordingly. In July and September, all sample totals were estimated using a one-fourth subsample. Flies (Diptera) and ants, bees, and wasps (Hymenoptera) were clearly the numerically dominant orders in the samples. The largest families in the order Diptera were midges (Chironomidae), anthomyiid flies (Anthomyiidae), gall midges (Cecidomyiidae), syrphid flies (Syrphidae), trixoscelidid flies (Trixoscelididae), and big-headed flies (Pipunculidae); all families were represented with over 100 individuals in the samples.

About 30% of the invertebrates taken by Malaise trap in June at this site were Chironomidae, and close to 13% were Anthomyiidae. Diptera also had the largest number of families (24). In Hymenoptera, 16 families were taken with Ichneumonidae, Braconidae, and Halictidae being the most abundant families.

Three of the above families are flower feeders as adults, including Chironomidae. Their combined total captures are just less than one-half of all captures at this site in June, and as such, they make up most of the flower feeder level (Table 3-7-297). Two of the remaining abundant dipteran families, Anthomyiidae and Trixoscelididae, make up 17 of the 21% total captures in the unknown feeding category.

Results from the greasewood-sagebrush site in July yielded 4,372 invertebrates in 88 species groups. Two families contained greater than 10% of the total numbers; leafhoppers (Cicadellidae) with 12% of the total captures, and anthom iid flies (Anthomyiidae) with 21.8%. Other families with greater than 5% of the total captures were dipterans and include midges (Chironomidae) and chloropid flies (Chloropidae). Diptera was by far the most abundant order captured, containing over 60% of the total captures. Hymenoptera, although containing less than 15% of the total captures, had over one-half of the species groups, with most of these in families of parasitic wasps (Table 3-7-298).

Anthomyiidae comprised a major portion of the high percentage of invertebrates in the unknown feeding category (Table 3-7-299). The second largest feeding category, flower feeders, contained a variety of Hymenoptera and Diptera. The last feeding category with over 10% of the total captures was the herbivore category, with leafhoppers making up nearly the entire group.

In September, Malaise trap captures from the greasewood-sagebrush habitat totaled 1,420 individuals in 62 species groups (Table 3-7-300). Three groups contained greater than 10% of the captures. Anthomyiid flies (Anthomyiidae) were the most abundant with 20% of the captures, followed by ant reproductives (Formicidae) at 16.9% and a group of several unknown adult moth species with 11.5% of the total captures. Of the remaining families, chloropid flies (Chloropidae) had 9.2% of the total captures. Of the 66 species groups, 56 were evenly divided among families of Diptera and Hymenoptera.

Flower feeders were the most abundant feeding type of the invertebrates captured (Table 3-7-301). Of the most abundant groups, the adult moths and Chloropidae are flower feeders, and made up just less than half of the total in this feeding

category. The remainder were a variety of families in Hymenoptera and Diptera. The remaining abundant feeding types, omnivores and unknowns, were made up primarily of ants and anthomyiid flies, respectively.

Over the sampling season, total captures declined from June to September, as did the number of species groups. Thirty-nine species groups were present in both June and July, including one species of Anthomyiidae which contributed 1,036 individuals in July and most of the 288 individuals in September. The abundant group in June samples, Chironomidae, showed large population decreases over the season accounting for much of the reduction in invertebrate numbers taken by Malaise trap from June to July.

The dominant anthomyiid fly species, which contributed significantly to total numbers in July, had only 44 representatives in September. In addition, 16 species groups present in July were also taken in September, including only a small group of leafhoppers (Cicadellidae) and chloropid flies (Chloropidae) which contributed 524 and 200 individuals respectively to the July totals. Overall, Site 1 had by far the largest total captures in Malaise traps of any site.

Flower feeders dominated the June samples, with much of this group in the nectar feeding Chironomidae. In July, the relative abundance of unknowns began to increase, based on relative increases of anthomyiid fly numbers. In September the feeding category showing the largest increase was the omnivore type, reflecting the increases in ant numbers in Malaise samples.

At the greasewood-sagebrush site, five Trap D-Vac samples were taken from rabbitbrush each sampling period. In June, 184 invertebrates were taken giving density estimates ranging from 182.6 to 2,101.3 invertebrates per cubic meter of plant sampled (Table 3-7-302). This resulted in a calculated average of 844.6 invertebrates per cubic meter of rabbitbrush at the greasewood-sagebrush site and a standard error of 341.7 (Table 3-7-303). An obvious source of variation in the samples taken from rabbitbrush is apparent when data from

individual plant samples are examined. The bulk of thrips (Thysanoptera) and leafhoppers (Cicadellidae) was taken from one plant (the second smallest plant), substantially increasing the number of invertebrates per cubic meter for that plant. The remaining abundant family (Anthicidae) was evenly distributed on all five rabbitbrush plants sampled (Table 3-7-304).

Of the 184 invertebrates captured, Thysanoptera was the most abundant order, contributing greater than one-fourth of the total. Two other families, leafhoppers (Homoptera:Cicadellidae) and ant-like flower beetles (Anthicidae) each contained more than 15% of the total captures. Herbivores dominated the feeding habit results, contributing 91% of the total captures (Table 3-7-305).

In July, the number of invertebrates per cubic meter of plant ranged from 172.7 to 2,544.6 for samples taken from rabbitbrush (Table 3-7-306). The average number of invertebrates was 1,024.5 per cubic meter of plant (Table 3-7-307).

A total of 107 invertebrates in 25 species groups was captured in July; 35% of these were in the order Thysanoptera (Table 3-7-308). Most of the thrips were taken from one plant, accounting for the high density estimate for sample no. 217. Other abundant groups included four species of leafhoppers (Cicadellidae), an antlike flower beetle (Anthicidae), and two species of snout beetles (Curculionidae), all with over 10% of the total captures.

Eighty-two herbivores were captured in Trap D-Vac samples from rabbitbrush in July, including all of the abundant groups except Anthicidae. This gives a percentage of 76.6% of the total captures in this feeding type (Table 3-7-309).

In September, 106 invertebrates were captured at the greasewood-sagebrush site for a range of 372.0 to 6,526.6 invertebrates per cubic meter (average of 1,979.7) (Tables 3-7-310 and 3-7-311). Thrips (Thysanoptera) made up 48% of the total invertebrates captured, with half of these obtained from one plant. Other

abundant groups were leafhoppers (Cicadellidae) with 13% of the total captures, snout beetles (Curculionidae) with 19%, and checkered beetles (Cleridae) with 7% of the total captures (Table 3-7-312).

As in June and July, September samples contained a large percentage of herbivores (Table 3-7-313). In Trap D-Vac samples from rabbitbrush at the greasewood-sagebrush site, total captures were higher in June (184) than in July or September (107 and 106, respectively); however, only 17 species groups were present during June compared to 25 and 26 in July and September, respectively. The average number of invertebrates per cubic meter of vegetation ranged from 844.6 in June to 1,024.5 in July to 1,979.7 in September.

Thrips (Thysanoptera) were the numerically dominant group in samples from the greasewood-sagebrush site in all sampling periods. Leafhoppers were also abundant in all sampling periods; however, species groups differed over the season. Delphacid planthoppers (Delphacidae), abundant homopterans in June, were not captured in July or September. In the order Coleoptera, antlike flower beetles (Anthicidae) comprised 19% of the invertebrates taken in June, 14% in July, with only one specimen taken in September. The remaining abundant beetle family was the snout beetles (Curculionidae) in which the same species groups were present each period. In addition, checkered beetles (Cleridae) were common in September samples. Herbivores were the dominant feeding type in all sampling periods.

b. <u>South Slope Pinyon-Juniper Habitat (Site 2)</u> - In pitfall samples from the south slope pinyon-juniper site taken in June, the density was 26.21 invertebrates per m^2, due mainly to the large numbers of Collembola (density = $22.92/m^2$). Feeding categories at Site 2 were dominated by saprovores, the primary feeding type of Collembola. The omnivore feeding category consisted of ants (Hymenoptera: Formicidae) while the predator category consisted of spiders (Araneida), pseudoscorpions (Chelonethida) and two families of beetles (Coleoptera: Carabidae, Staphylinidae) (Tables 3-7-314 and 3-7-262).

July pitfall results for the south slope pinyon-juniper site yielded 913 ground-dwelling invertebrates with a density estimate of 8.41 invertebrates per m^2 (Table 3-7-315). Mites (Acari) and ants (Hymenoptera: Formicidae) accounted for 80.72% and 9.31% of the total numbers captured, respectively.

The food habit classification for invertebrates captured in July at the south slope pinyon-juniper site showed 81.1% unknowns, made up mostly of mites (Table 3-7-264). Ants made up the second largest level, omnivore, with 9.3% of the total captures.

In September, 219 invertebrates in eight orders were captured giving an estimated density of 2.90 individuals per m^2 (Table 3-7-316). Ants (Hymenoptera: Formicidae) and spiders (Araneida) were the numerically dominant orders, accounting for 73.88% of the total captures. Twenty-three adult flies (Diptera) were also captured at this site. The numerical dominance of ants and spiders in September at the south-slope pinyon-juniper habitat is reflected in the high percentages of their feeding types. Omnivores, consisting entirely of ants, contained 41% of the total captures and predators, primarily spiders, contained 35.5% (Table 3-7-266).

Over the sampling season, large fluctuations in total captures of two insect orders were the primary changes in the fauna. Collembola accounted for 89.13% of the total number of insects collected in June, dropping to less than 3.0% in July and September. By contrast, numbers of captured Acari went from 5.9% of the total in June to 80.72% in July; Acari was absent in September. Thysanura and Coleoptera demonstrated no large changes in numbers captured over the three sampling periods. Spider (Araneida) captures increased by five times in September over the earlier sampling periods. Ant (Hymenoptera: Formicidae) captures in July and September doubled from those of June. Throughout the sampling season three scorpions and one sun-spider were taken within the grid.

Changes in the dominant feeding type over the summer reflect the total captures of Collembola and Acari each period. In June, 90% of the captures were

Collembola, thus the largest feeding group was saprovore. Acari increased in July samples to become the numerically dominant order, resulting in 81% of the invertebrates from those samples falling into the unknown category. In September, relative abundance of both Acari and Collembola was low, and the omnivore and predator levels contained the largest percentages of the total captures.

In litter samples from the south slope pinyon-juniper habitat, only one sample in June contained more than four invertebrates per kilogram litter (Table 3-7-317) yielding a low overall average of 1.8 invertebrates per kilogram of litter for this site. Actual captures show only three ants taken in five samples (Table 3-7-269) an extremely low figure in view of the fact that duff layers were thick where samples were taken.

Captures of invertebrates per kilogram of litter ranged from 4.5 to 54.2 at the pinyon-juniper/south slope habitat in July for an average of 33.6 and a standard error of 10.8 (Table 3-7-271). Explanations for the large range of habitats for this site are examined. Sample numbers 263, 264, and 267 were taken from pinyon litter while numbers 265 and 266 were taken under juniper (Table 3-7-318). Within these microhabitats, variations in numbers per kilogram litter were small, with a range of 48.7 to 54.2 for pinyon samples and 4.5 to 9.9 for juniper.

Eighty-two percent of the 131 invertebrates captured in July litter samples at the south slope pinyon-juniper site consisted of elongate-bodied springtails (Collembola: Entomobryidae - 31%), mites (Acari - 34%), rove-beetles (Staphylinidae - 8%), and pseudoscorpions (Chelonethida - 9%). Of these groups, Chelonethida was evenly distributed among the microhabitats, with the rest showing a definite preference for litter under pinyon pine (Table 3-7-273). Feeding habit results for July litter captures show three feeding categories with more than 15% of the total captures (Table 3-7-274). The unknown category was made up primarily of mites and the saprovore category was primarily Collembola. Rove beetles (Staphylinidae) and pseudoscorpions (Chelonethida) made up the predator category.

An average of 47.0 invertebrates per kilogram of litter was taken from five litter samples at the south slope pinyon-juniper site in September. This figure is based on a range of 10.9 to 96.9 (Table 3-7-319). The two largest samples were taken under shadscale and greasewood and contained 96.9 and 84.8 invertebrates/kilogram of litter. Low numbers of invertebrates per kilogram of litter were obtained from samples taken under pinyon pine and juniper.

Sixty-eight percent of the 107 invertebrates captured at Site 2 in September were mites (Acari) and these were taken primarily from the shadscale (33 of the 73 mites captured) and greasewood (25 of 73) samples. Other numerically important groups, beetle (Coleoptera) and spider (Araneida) immatures, were found in all five litter samples (Table 3-7-277).

Feeding habits for the invertebrates captured in the south slope pinyon-juniper habitat litter in September reflected the numerical dominance of mites which were designated as unknown in their feeding preferences (Table 3-7-278). Of the remaining feeding types, the predator category contained 13.1% of the total captures, the bulk of which were spiders.

Comparisons of results for all three sampling periods for the litter of the south slope pinyon-juniper habitat show an average of 1.8 invertebrates per kilogram of litter in June increasing to 33.6 in July (Table 3-7-271), and 47.0 in September (Table 3-7-275). During all three sampling periods population trends varied within and between the three microhabitats studied. In pinyon litter, the number of invertebrate captures peaked in July and then dropped off substantially in September. In contrast, juniper and shadscale litter samples increased over the sampling season, although the increase in invertebrates in juniper litter is small compared to that in shadscale litter. The most obvious explanation for these trends lies in the capture numbers of Collembola and Acari in July and September. The highest capture of Collembola occurred in July, primarily in pinyon litter, which accounts for the numbers peak in that litter type. Acari captures increased in July and September in both juniper and shadscale litter.

Of the three species of ants found in the June litter samples, only one species was present in the remaining sampling periods. Three other species were present for both the July (Table 3-7-273) and September (Table 3-7-277) sampling periods. These were elongate-bodied springtails (Entomobryidae), pseudoscorpions (Chelonethida), and barklice (Psocoptera).

Feeding habits of the litter captures at this site reflected the presence or absence of relatively large numbers of Collembola and Acari in the July and September periods.

In herbaceous sweep samples from the south slope/pinyon-juniper habitat in June, 48 invertebrates were captured, representing 21 species groups (Table 3-7-279). Of this total, about one-fifth were from each of two families--plant bugs (Hemiptera: Miridae) and eulophid wasps (Hymenoptera: Eulophidae). Other families with relatively large numbers were Psyllidae and Formicidae, both of which contributed 15% or more to the total captures.

Herbivores were the most abundant group captured in June (48% of the total captures) (Table 3-7-280). Within the herbivore feeding type, Miridae and Psyllidae were the most abundant families, with various other Homoptera also included. Flower feeders, the next most abundant group, was composed of two parasitic Hymenoptera families and one family of flies (Chloropidae). The omnivore category was composed exclusively of ants.

In July at the south slope pinyon-juniper site 80 invertebrates in 15 species groups were captured (Table 3-7-281). Sixty percent of the total captures were contained in two families, globular springtails (Sminthuridae) with 27.5% and leafhoppers (Cicadellidae) with 32.5% of the total. Acari made up 16% of the total.

As both of the numerically abundant groups are plant sap feeders, the herbivore level at the south slope pinyon-juniper site contains over 60% of the total captures (Table 3-7-282). The second largest feeding type is the unknown (16.3%) which is made up of mites (Acari).

In September, 35 species groups yielded 156 invertebrates in herbaceous sweep samples at the south slope pinyon-juniper site (Table 3-7-283). Numerical dominants were leafhoppers and aphids (Aphididae) which contained 42% and 20% of the total captures, respectively. Eulophid wasps (Eulophidae) was the only other family which contained greater than 5% of the total captures.

The majority of the herbivores were in the two numerically dominant families, Cicadellidae and Aphididae (Table 3-7-284). Both are plant sap feeders. The second most abundant feeding type, flower feeders, was made up of adult flies (Diptera) and wasps (Hymenoptera).

Over the entire season, total captures were greatest in September as was the total number of species groups. Of the numerically dominant families in June samples, only the ants (Formicidae) and eulophid wasps (Eulophidae) were present in all sampling periods. The parasitic wasps are short-lived individuals. Neither of the leafhopper species groups common in July was present in September, but the second largest group, Sminthuridae, was found in small numbers in the latter sampling period.

Herbivores were the abundant invertebrate feeding type captured during all sampling periods in the south slope pinyon-juniper habitat. The abundant taxa in the herbivore category varied from period to period, with Miridae and Psylidae in June, Sminthuridae and Cicadellidae in July, and Cicadellidae and Aphididae in September. Dipteran and hymenopteran flower feeders, represented by a variety of families and species groups, were relatively abundant in all sample periods. Omnivores, unknowns, or predators were also relatively abundant in one or more sampling periods.

In beating samples taken from pinyon pine at the south slope pinyon-juniper habitat in June, 32 invertebrates were captured in eight species groups. Ants and mites accounted for 68% of the captures.(Table 3-7-285).

Feeding habits reflect the numerical dominance of ants and mites, with 50% omnivores and 20% unknowns. (Table 3-7-286).

Beating samples from pinyon pine at the south slope pinyon-juniper site in July contained 142 invertebrates in 27 species groups (Table 3-7-287). Numerically dominant groups included a species group of immature plant bugs (Miridae) with 32% of the total captures and two species groups of thrips (Thysanoptera) with 25%. Of the total captures, half of the species encountered were in the order Hymenoptera; three-quarters of these were parasitic wasps.

Herbivores were the numerically dominant feeding type with 65.2% of the total captures, including both of the most abundant groups. The second largest group, predators, consisted of individuals from Araneida, Hymenoptera, Diptera and Coleoptera. (Table 3-7-288).

In September, 92 invertebrates representing 18 species groups were captured in beating samples from pinyon pine at the south slope pinyon-juniper habitat. Over half of these were of one species group of globular springtails (Sminthuridae). None of the remaining groups contributed more than 7% of the total captures. (Table 3-7-289).

Sminthuridae made up most of the captures in the herbivore feeding category in the September beating samples (Table 3-7-320). Predators, which contributed 19.6% of the total captures, were all spiders (Araneida).

Capture totals and numbers of species groups in the south slope pinyon-juniper beating samples from pinyon pine peaked in the July sample. Three species groups were present in both June and July samples. Four species groups were present in both July and September samples, including Sminthuridae which was the most abundant family in September. The Miridae nymph collected commonly at this site in July was not present in June or September samples.

Feeding habit percentages for each sampling period reflect the low total captures of herbivores in June. Ants and mites, which made up the bulk of the abundant feeding types in June, were not captured in substantially smaller numbers in July or September, but different groups of herbivores with relatively high capture totals in July and September decreased the relative abundance of total captures of omnivores and unknowns in the latter two periods.

Beating samples from juniper at the south slope pinyon-juniper site (Sample 2J) in June contained 122 invertebrates in 11 species groups (Table 3-7-285). Eighty-six percent of the captures were contributed by one species group of plant bug (Miridae). This is reflected in the percentage of total numbers in each feeding type where herbivores make up 87% of the captures (Table 3-7-286). Miridae are plant sap feeders.

In beating samples from juniper (Sample 2J) in July, a total of 97 invertebrates in 21 species groups was taken (Table 3-7-287). Dominant groups at this site were Sminthuridae with 32% of the total, Miridae nymphs with 12%, Dictynid spiders with 10% and psyllids (Psyllidae) with 9%, and Acari with 12% of the total captures.

Feeding habits show 60.7% of all captures from juniper at this site in July are herbivores, primarily Sminthuridae, Miridae, and Psyllidae (Table 3-7-288). The second most abundant feeding type, predator, consisted primarily of dictynid spiders.

September results for beating samples from juniper at the south slope/pinyon-juniper habitat (2J) had 10 species groups containing 17 individuals. Only two groups, mites (Acari) and dictynid spiders (Dictynidae), had more than two individual captures (Table 3-7-289). Nine herbivores were taken including two larval specimens of a conifer sawfly (Diprionidae), giving a total of 56.3% of the captures in the feeding type (Table 3-7-320).

Over the season, the most significant change in the invertebrate fauna captured was the loss of the large Miridae population present in the June samples. This group was the primary contributor to the peak in total numbers occurring in June. Five species groups were present in both the June and July results, although only one was an insect (a bark louse - Psocoptera). The rest were mites and spiders. September results contained a small number of the springtails which were common in July, and one specimen of an abundant species group of plant bug (Miridae) found in June.

Herbivores were the most numerous invertebrates captured in all three sampling periods at Site 2J. In June, the herbivore feeding type was primarily one species group of Miridae, while in July, a group of three families contributed to the total. In September, the herbivore level was made up of several groups with small total captures.

Aerial sweep samples from the foliage of pinyon pine at the south slope pinyon-juniper habitat (Site 2) in June contained only seven invertebrates in seven species groups (Table 3-7-290). Predators were the largest feeding type, containing three individuals, while the herbivore and flower feeder level each contained two (Table 3-7-291). Only one family was found only in pinyon pine at this site, Agromyzidae, a leaf-miner fly which is normally associated with deciduous species.

Aerial sweeps from pinyon pine at Site 2 in July contained 31 individuals in 15 species groups. Over half the total numbers were in the families of checkered beetles (Cleridae) and eulophid wasps (Eulophidae) (Table 3-7-292).

Twelve invertebrates, including the abundant family of beetles (Cleridae), were considered predators giving this feeding type the largest percentage of total captures at 38.7 (Table 3-7-293). The remaining family considered abundant (Eulophidae) is a parasitic wasp family whose adults make up two-thirds of the second largest feeding type, flower feeders.

In September, 38 individuals in 21 species groups were present in the aerial sweep sample from pinyon pine at the south slope/pinyon-juniper site, one-third

of which were plant bugs (Miridae) (Table 3-7-294). No other family contributed more than three individuals to the sample except Eulophidae, which was also a common family in July.

A combination of four Homoptera families and the abundant hemipteran family, Miridae make up the bulk of the 63.2% herbivores taken in aerial sweeps at Site 2 in September (Table 3-7-295).

Over the season, aerial sweep samples from pinyon pine at the south slope pinyon-juniper habitat showed a numerical peak in September. Abundant families each period varied with one exception, Eulophidae, which was common in July and September, but with different species groups making up the total each time.

Herbivores were the abundant feeding type in sweep samples from pinyon pine only in September. In June and July, predators were most common, with different contributing groups in each period.

Aerial sweep samples from the foliage of juniper at the south slope/pinyon-juniper site (Site 2) contained 95 invertebrates in eight species groups in June (Table 3-7-290). Eighty-seven percent of the total captures were of one species group in the family Miridae, with globular springtails (Sminthuridae) the only other group with more than two individuals. These two groups and one moth larvae were the only herbivores in the samples but represent 95% of all captures (Table 3-7-291).

Fifty sweeps from juniper foliage in July at Site 2 show 39 invertebrates in 17 species groups (Table 3-7-292). Nearly half of the total captures and number of species groups belong to a variety of parasitic wasp families (Hymenoptera). The majority of the remaining total numbers are contained in Sminthuridae and Miridae.

Despite the fact that three parasitic wasp families contained greater than 10% of the total captures, the herbivore level is the most abundant feeding type (Table 3-7-293). Both of the most abundant families are included in this group, along with individuals from four other orders. The flower feeder level consisted of

most of the Hymenotpera. The last feeding type, predator, contained over 15% of the total captures and consisted of a Hymenoptera famioy and a spider family.

September results from aerial sweeping of juniper foliage contained 43 invertebrates in 13 species groups, the second largest total captures in aerial sweeps from all sites sampled in September. Plant bugs (Miridae) and froghoppers (Cercopidae) accounted for 32 of the 43 total captures (Table 3-7-294).

The abundance of herbivores in the feeding habit results for September samples at Site 2, 83.7% of the captures (Table 3-7-295), reflects the capture totals of Miridae and Cercopidae.

Over the season, invertebrate captures from aerial sweeps of juniper foliage at the south slope pinyon-juniper habitat fluctuated, with the highest total in June, and the lowest in July. The abundant plant bug species group from June was also relatively abundant in July, but absent in September samples, although another species group of the family was present. Only globular springtails (Sminthuridae) were present in all sampling periods.

Herbivores were the numerically dominant invertebrates in all periods, usually with either Miridae or Sminthuridae as one of the major components. In July, there were a large number of parasitic wasp adults which contributed to the large percentage of flower feeders found only in this period.

The Malaise trap in the south slope pinyon-juniper habitat (Site 2) contained an estimated 2,872 invertebrates after 10 days in June (Table 3-7-296). Six groups contributed a total of 62% of the total captures, including five families of flies (Diptera). The most abundant groups, anthomyiid flies (Anthomyiidae) and a variety of adult moths (Lepidoptera), each contained 13.6% of the captures.

Flower feeders dominated the Malaise captures at Site 2 in June, with the bulk of these in the abundant groups of adult moths, Chironomidae, and Sciaridae. Only one other feeding type, unknowns, contained greater than 10% of the captures, with nearly three-fourths of this total in one family - Anthomyiidae. (Table 3-7-297).

July results for Malaise trap captures from the south slope pinyon-juniper habitat contained 636 invertebrates in 41 species groups (Table 3-7-298). Five groups each contained greater than 5% of the captures, led by a variety of adult moths which made up 27.6% of the total, gall midges with 16.3%, a variety of Homoptera with 10%, and anthomyiid flies and tiphiid wasps (Tiphiidae) with over 5% each. In July less than one-half of the total species groups captured were in the order Diptera.

Feeding habit results for invertebrates captured in the Malaise trap at the south slope pinyon-juniper habitat in July show flower feeders as the largest group with 50.9% of the captures. Over one-half of this total were adult moths, the only abundant group in this feeding type. Unknowns, the second largest group with 28.9% of the total captures, consisted primarily of Cecidomyiidae and Anthomyiidae. (Table 3-7-299).

In September, results at Site 2 for Malaise trap sampling revealed 424 invertebrates in 24 species groups (Table 3-7-300). Of this total, four groups contain over 10% of the captures, led by anthomyiid flies with 22.6%, a variety of homopterans with 17.9%, a variety of adult moths with 15.1% and scarab beetles (Scarabaeidae) with 11.3%. These groups show a combined total of 66.9% of all captures. Fourteen of the 24 species groups are contained in 10 families of flies (Diptera).

Feeding habits for the captures at Site 2 in September show flower feeders as the abundant feeding type with one numerically abundant group, adult moths, and a variety of Hymenoptera and Diptera included. The second largest group, unknowns, was primarily anthomyiid flies (Table 3-7-301).

Over the season, capture totals decreased from 2,872 invertebrates in June to 424 in September. Anthomyiidae was the most abundant family taken all season, with one species group abundant in June, a different one in July, and both present and abundant in September. In all, 16 species groups present in June were also found in July, including a fall midge (Cecidomyiidae) abundant in both periods. Eight of these groups were also present in September with only the anthomyiid flies considered abundant.

Trap D-Vac samples were taken from shadscale (Atriplex confertifolia) in the south slope pinyon-juniper habitat. In June, the average for five shadscale plants sampled was 277.7 invertebrates per cubic meter of plant with a standard error of 100.2 (Tables 3-7-303).

Variation in the number of invertebrates per cubic meter of shadscale at the south slope pinyon-juniper site ranged from 67.3 to 611.2. The average for the five shadscale plants was 277.7 invertebrates per cubic meter with a standard error of 100.2 (Tables 3-7-321 and 3-7-303). Forty-three invertebrates in 14 species groups were captured at this site with a species group of Tortricoidea larvae (Lepidoptera) making up over one-third of the total captures (Table 3-7-304). Other abundant groups included scale insects in the superfamily Coccoidea and leafhoppers (Cicadellidae), each with eight individuals. Ninety-three percent of all captures were herbivores (Table 3-7-305).

Sixty invertebrates were captured in five samples from shadscale at the south slope/pinyon-juniper site in July. Results are presented in Tables 3-7-307 and 3-7-322. The number of invertebrates per cubic meter of plant averaged 709.2 with a standard error of 377.1.

Sixty percent of the invertebrates captured were leafhoppers (Cicadellidae) and midges (Chironomidae) (Table 3-7-308). Both families were picked up on all plants sampled, and the majority of specimens within each family belonged to one species group. In all, 21 species groups were taken from shadscale foliage at this site in July.

Eighty-eight percent of the total captures were comprised of invertebrates in two feeding types, herbivores with 40.0% and flower feeders with 48.3% (Table 3-7-309). The abundant families made up the bulk of the two feeding types with leafhoppers containing 14 of the 24 herbivores and Chironomidae containing 22 of the 29 flower feeders (Table 3-7-308).

In September, the number of invertebrates per cubic meter averaged 2,035.8 with a standard error of 1,147.1 (Tables 3-7-323 and 3-7-311). Actual captures totaled 24, with the invertebrates relatively evenly divided among four samples.

The numerically dominant family was an unknown homopteran in the superfamily Coccoidea, which contributed seven individuals (29% of the total), six of which were in one sample (Table 3-7-312). Two species groups of leaf beetles (Chrysomelidae) and three species groups of leafhoppers (Cicadellidae) made up the next most abundant taxa.

The eight invertebrates in the Berlese calibration sample were all leafhoppers, an indication that this family is numerically more important than results show. Feeding habit percentages reflect the feeding types of the abundant taxa. All were herbivores which made up the bulk of the 87.5% of the total captures (Table 3-7-313).

Over the sampling season at the south slope pinyon-juniper habitat, the average number of invertebrates per cubic meter of shadscale plants increased from 277.7 in June to 2,035.8 in September; however, total captures were highest in July (60) and dropped to 24 in September. The numerically dominant group which appeared in all samples was Cicadellidae (leafhoppers). Scale insects (superfamily Coccoidea) were important numerically in June and September, but were comprised of two distinct and different species of active immatures. The last abundant group captured in June, moth larvae in the superfamily Tortricoidea, was caught in relatively large numbers but was absent from later samples.

In July, midges (Chironomidae) were the most abundant group sampled. The three species groups captured in July were not present in samples from shadscale in June or September.

In addition to previously mentioned families, September samples contained two abundant species groups of leafbeetles (Chrysomelidae), neither of which was present prior to September.

Total captures at this site were comparable to other sites in all sampling periods, including the second highest total in July. In July, Site 2 contributed 21 species groups.

c. North Slope Pinyon-Juniper Habitat (Site 3) - Results for the north slope pinyon-juniper ground-dwelling invertebrates sampled in pitfalls in June show 387 individuals captured from eight orders. The total calculated invertebrate density at Site 3 was 0.60 individuals/m^2 (Table 3-7-324).

Highest total captures were in the order Collembola (240 individuals) followed by Coleoptera (59 individuals) and ants (39 individuals).

Feeding habit results for pitfall captures at the north slope pinyon-juniper habitat showed 62% saprovores, all litter-dwelling Collembola. Predators, which consisted of all of the spiders (Araneida) and beetles (Coleoptera), were the next abundant feeding category.

Twelve hundred and two invertebrates (in nine orders) were captured in pitfalls at Site 3 (north slope pinyon-juniper) in July. Acari was the most numerous group captured with 600 individuals (diversity = 5.14/m^2). (Table 3-7-325).

The unknown feeding category dominated the north slope pinyon-juniper ground-dwelling fauna. This category was comprised entirely of mites (Acari) and made up 50.2% of total captures. The next most abundant feeding category was saprovores with 33.9% of the total captures, made up primarily of Collembola. All of the ants were omnivores. Beetles (Coleoptera) contributed to the saprovore, herbivore, and predator levels.

In September, 425 individuals in nine orders were captured in the north slope pinyon-juniper habitat (14.65 individuals per m^2) (Table 3-7-326). The largest order, Acari, accounted for 80% of the total captures.

The saprovore level contained only 4.0% of the total captures and included Collembola, Phalangida, and some Coleoptera. The predator feeding category was composed of spiders (Araneida), beetles (Coleoptera), and one centipede (Geophilomorpha).

Over the entire sampling period, total captures went from 387 individuals in June to 1,202 in July and 423 in September.

The numerically dominant groups were Collembola and Acari. Collembola was the dominant group captured in June (62% of the total captures). Acari accounted for 80% of the total captures in September. In July, Acari accounted for almost 50% and Collembola over 33% of the total captures.

The dominant feeding type varied for each sample period relative to the invertebrate group which was numerically dominant in the samples. In the cases of both Collembola and Acari, their respective feeding habits (saprovore and unknown) contained relatively few individuals of any other order, and as a result the percentage of total captures in the feeding types saprovore and unknown are almost identical to the percent relative abundance of Collembola and Acari.

Results of the litter D-Vac sampling at the north slope pinyon-juniper habitat are similar to those from the south slope pinyon-juniper site in June in that small numbers of invertebrates per kilogram of litter were captured in all samples (Table 3-7-327). The average was 5.0 invertebrates per kilogram of litter (Table 3-7-268). Of the five samples, three were taken from pinyon pine litter and contained 14.5, 0.0 and 9.3 invertebrates per kilogram of litter. The remaining two samples were taken from the juniper duff and contained 0.0 and 3.1 invertebrates per kilogram litter.

Feeding habits for the 13 invertebrates taken in litter samples at the north slope pinyon-juniper site in June showed the predator category as the most abundant, containing four beetles and one spider (Table 3-7-270).

The number of invertebrates per kilogram of litter ranged from 20.4 to 82.6 in the north slope pinyon-juniper habitat in July (Table 3-7-328). The average number per kilogram of litter derived from these five samples is 61.3 with a standard error of 11.8. As at Site 2, there are large differences in total invertebrate numbers based on the microhabitat sampled. Pinyon pine litter yielded 80.9, 73.3 and 82.6 invertebrates per kilogram of litter while only 10.2 and 24.8 invertebrates were found per kilogram of juniper litter

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Variation in the numbers of invertebrates in pinyon samples was minimal. The large variation in juniper samples may be explained by looking at the fauna captured. In the juniper sample with the largest number of invertebrates, 43 of 45 invertebrates captured were ants (Hymenoptera: Formicidae), which indicates that this sample was probably taken over the opening of an ant nest.

In all, a total of 238 invertebrates in 23 species groups were captured from litter samples at the north slope pinyon junipersite in July. Litter samples at this site contained three numerically dominant groups including two families of Collembola with 28% of the total captures, three species of ants (Hymenoptera: Formicidae) with 43% of the total captures, and a variety of mites (Acari) with 12% of captures (Table 3-7-273). All Collembola and most of the Acari came from pinyon litter, while ants were found in all samples.

Invertebrate food habitat classification for the north slope pinyon-juniper habitat reflects the large number of ant captures. Accordingly, 43.3% of the invertebrates captured were classed as omnivores (Table 3-7-274). The next most abundant food category, saprovore, was composed primarily of Collembola, while the third, unknown, was primarily mites. The last remaining abundant level, predator, was composed of spiders, pseudoscorpions, and stilletto fly larvae (Therevidae). In September, an average of 44.7 invertebrates per kilogram of litter was taken from the samples at the north slope pinyon-juniper habitat (Table 3-7-275). Five samples ranging from 3.9 to 111.2 invertebrates contributed to this average, and to the standard error of 24.2.(Table3-7-329). Two sample were taken in duff under pinyon pine, and contained 96.3 and 111.2 invertebrates per kilogram of litter respectively. The remaining three samples were taken in juniper duff and all contained less than eight invertebrates per kilogram of litter (Table 3-7-330).

Ants (Hymenoptera: Formicidae) and mites (Acari) made up 69% of the invertebrates captured in September (Table 3-7-277). Other relatively abundant groups were springtails (Collembola: Isotomidae) and bark lice (Psocoptera). All of the mites and Collembola were in one pinyon litter sample, and the ants were in the other. This concentration of ants in one sample is again indicative

of a nest located beneath the duff within the area vacuumed. Omnivores were the most abundant invertebrates captured at the north slope pinyon-juniper in September (Table 3-7-278); all were ants. The second largest feeding category, unknown, consisted entirely of mites. The remaining two feeding levels, saprovores and predators, were also abundant in samples.

There was an increase in the average number of invertebrates per kilogram of litter over the summer, from 5.0 in June to 44.7 in July (Table 3-7-271) to 61.3 in September (Table 3-7-275). In the pinyon pine duff samples, ranges increased from less than 15.0 in June to 70.0-80.0 in July and over 95.0 in September, while in juniper samples, numbers increased from less than 4.0 in June to over 20.0 in July, and down to less than 8.0 individuals per kilogram of litter in September.

In pinyon pine duff samples, the increased numbers in July from June are primarily attributed to increases in captures of one ant species also found in June, and to an abundance of Collembola not present in the June sampling period. September samples also contained high numbers of an ant species found in previous sampling periods, but Collembola numbers were much reduced.

Juniper litter sample peaks in July are based on increases in ant (Hymenoptera: Formicidae) captures in both samples (Table 3-7-273). The three major groups encountered in the July samples, Collembola, Acari, and Formicidae, were not abundant in June. The Collembola population peaked in July and was still present in September. Acari increased from 0 in June to 57 individuals per kilogram of litter in September samples, while ants peaked in numbers in July and were less abundant in September although still quite common. The results for Formicidae are biased by the presence of ant nests within the sample boundary in both the July and September samples. A comparison of species present in litter samples between June and July shows that four of the 10 species taken in June were present and more abundant in the July samples. Seven species present in September samples were also found in July samples, and three of the four species common during the first two sampling periods were also present in September. These three species included an ant (Hymenoptera: Formicidae), a beetle (Coleoptera: Curculionidae and a ground beetle larvae (Coleoptera:

Carabidae). Spider families and mites were present throughout the three sample periods. The predator feeding category was the most abundant in June samples. In July and September omnivores (primarily ants) were the most abundant feeding group. The relative importance of other levels, specifically saprovore and unknown, are based almost wholly on the number of Collembola and mites. Consequently, saprovores were more abundant in July, while unknowns were more abundant in September.

Herbaceous sweep samples from the north slope pinyon-juniper habitat in June had the second lowest total captures taken in any habitat or sampling period throughout the season (Table 3-7-279). Of the 29 invertebrates in 16 species groups, 28% were ants, and 20% each were delphacid planthoppers (Homoptera: Delphacidae) and leafhoppers (Cicadellidae). No other group contained more than two individuals.

The dominant feeding category in the June herbaceous sweep samples was herbivore, including both of the abundant Homoptera families listed above, plant bugs (Miridae), a short horned grasshopper (Acrididae) and two beetles (Table 3-7-280). Ants made up the second most abundant feeding type, omnivores, and several fly and wasp families contributed to the third largest feeding type, flower feeders.

Twenty species groups contributed 35 individuals in herbaceous sweep samples at the north slope/pinyon-juniper habitat in July (Table 3-7-281). Of these 35 specimens, 31% were ants (Formicidae), making this by far the most abundant family captured. Other abundant types included globular springtails (Sminthuridae) and leafhoppers (Cicadellidae), both with greater than 14% of the total captures.

The abundance of ants in the herbaceous sweep sample from the north slope pinyon-juniper habitat made the omnivore category the second largest in September. The remaining abundant families contributed to the herbivore level, the most abundant feeding type at the north slope pinyon-juniper site in July (Table 3-7-282).

In September, 90 individuals representing nine species groups were captured from the north slope pinyon-juniper habitat (Table 3-7-283). Eighty percent of this total was contributed by one species group of psyllids (Homoptera: Psyl idae).

Herbivores contained 93.3% of the total captures in September (Table 3-7-284). Seasonal trends in total captures peaked in September with 90 individuals, while the number of species groups was largest in the early periods and showed a low of nine in September. Of the abundant families present in June, all three were present in July, when both leafhoppers and ants were abundant. The remaining abundant group in July, globular springtails (Sminthuridae), not present in the June or September samples. Three species groups captured in July were also captured in June including the two species of ants which made up the abundant family in the early period. No species groups were found in both the July and September samples. Overall, the north slope pinyon-juniper site was consistently low in both total invertebrate numbers and diversity (number of species groups). Herbivores were the dominant invertebrates in all sample periods in the herbaceous stratum of the north slope/pinyon-juniper habitat.

Beating samples from pinyon pine at the north slope pinyon-juniper habitat (Site 3P) in June yielded only 12 invertebrates in seven species groups (Table 3-7-285). Of this total, 50% of the captures were evenly divided among crab spiders (Thomisidae) and assassin bugs (Reduviidae). Only one other species group contained greater than one individual, an unknown hemipteran nymph. Feeding habit percentages of total captures show 67% predators, including both of the abundant families listed above (Table 3-7-286).

Results of beating two pinyon pine trees at Site 3 in July showed 124 invertebrates representing 22 species groups (Table 3-7-287). Just less than half of the captures were the same Miridae nymph which was also dominant on pinyon pine at Site 3P in July. Three other groups contained 10% or more of the total captures - Thysanoptera, Cicadellidae, and Aphididae. Of the 22 species groups present, one-third are parasitic wasps. One hundred of the 124 captures from pinyon pine of the north slope pinyon-juniper habitat in July were herbivores, giving a percentage of 80.6 (Table 3-7-288).

This feeding habit includes all of the numerically abundant groups mentioned above.

In September, 27 individuals in 15 species groups were captured in beating samples from pinyon pine at Site 3P (Table 3-7-289). The dominant family in terms of total captures and number of species groups was the family of assassin bugs (Reduviidae), followed closely in total numbers by an unknown family of spiders. Of the 27 total captures, just under one-half were Araneida.

The predator level was the most abundant feeding type in the September beating samples with 81.5% of the total captures, including the spiders and assassin bugs (Reduviidae), as well as ladybird beetles (Coccinellidae) and a brown lacewing (Neuroptera: Hemerobiidae) (Table 3-7-321).

Total captures in beating samples from pinyon pine at the north slope pinyon-juniper habitat peaked in July due primarily to the abundance of a Miridae nymph, which was not picked up in June or September. Only three families were present throughout the season in the juniper beating samples, two spider families, and the assassin bugs (Reduviidae), which were present as immatures in June and adults in September. Changes in dominant feeding types are primarily related to the large number of herbivorous miridae found in July. In both June and September samples, the predator level consisted of basically the same groups and total captures.

Beating samples from juniper at the north slope pinyon-juniper habitat (Site 3J) in June contained 17 invertebrates in nine species groups (Table 3-7-285). Of this total, four were the same species group of plant bugs (Miridae) found in abundance in juniper samples at the south slope pinyon-juniper site. No other family contributed more than three invertebrates to the total captures; however, the order Araneida contained six individuals for greater than one-third of the captures.

Fifty-three percent of the captures were herbivores, including Miridae, making this feeding type the most common in the June juniper beating samples at Site 3J (Table 3-7-286). Six of the remaining eight invertebrates were predators

(all spiders), making this the second most abundant feeding type with 35% of the total captures.

Juniper beating samples at Site 3J in July revealed 13 species groups containing 35 individuals, both low totals for all beating samples in the July sampling period (Table 3-7-287). Numerically dominant groups included mites (Acari) and snout beetles (Curculionidae), which together accounted for almost half of the total captures. Other groups with greater than 10% of the total captures were Miridae and dictynid spiders (Dictynidae), each with five individuals captured.

Five of the feeding type categories which describe the fauna captured in beating of juniper at the north slope pinyon-juniper site in July contain over 5% of the total captures (Table 3-7-288). Herbivores were most common, with five orders contributing to the 15 captures, while the next two most abundant feeding types, unknown and predator, each contained only one group (Acari and Araneida, respectively).

September results from beating of juniper at Site 3J showed 31 specimens in 14 species groups (Table 3-7-289); 16 specimens were included in two species groups of barklice (Psocoptera). Only two other families contained more than one individual, Sminthuridae (Collembola) and Dictynidae (Araneida).

Saprovore, the feeding type of the abundant Collembolan family, contained 51.6% of the total captures in September samples of juniper beating at Site 3J (Table 3-7-295). The second most abundant feeding type, predator, was comprised primarily of spiders.

Seasonal trends in faunal characteristics of invertebrates captured by beating juniper trees in the north slope pinyon-juniper habitat revealed no peak in total captures, with essentially the same number of invertebrates taken each period. Overall, captures from beating juniper at Site 3J were very low in numbers and species groups relative to other sites.

Over the season, only one insect species group (in Curculionidae) was present in both early periods (June and July), along with two families of spiders. September results also contained the two spider families (Dictynidae and Thomisidae) found in the previous two periods as well as one species group of Psocoptera. Only two specimens of the latter species group were captured in July, but the group was numerically dominant in September.

The foliage of pinyon pine at Site 3 (north slope pinyon-juniper habitat) yielded five invertebrates in three species groups in June aerial sweeps (Table 3-7-290). Three of these individuals were ants, giving a percentage of 60 for the omnivore feeding type (Table 3-7-291).

In July, aerial sweep samples from pinyon at Site 3 contained 52 individuals, which were relatively evenly distributed among 28 species groups (Table 3-7-292). The largest family (Aphididae) contained only 13% of the total captures and was the only family with over 10%. Hymenoptera contributed more than 30% of the species groups captured, but made up less than one-fourth of the individual captures.

July sweep samples from pinyon pine reveal three feeding types with over 20% of the captures (Table 3-7-293). The numerically dominant type, herbivore, contained a variety of families from Hemiptera, Homoptera, Coleoptera and Lepidoptera. This is also true of the predator and flow feeder levels, each of which contain members of three orders.

September sweep samples from pinyon pine foliage at the north slope pinyon-juniper habitat contained 13 species groups with 24 individuals, none of which were plant bugs (Miridae) (Table 3-7-294). The second largest family, pteromalid wasps (Pteromalidae), contained six individuals in five species groups. Two spider families were the only others contributing more than one individual. Pteromalidae contained over one-third of the 13 species groups and was the only family with more than two species groups.

Feeding habit results show two types with at or near 50% of the total captures (Table 3-7-295), led by the herbivore level with 12 individuals of which nine

were plant bugs (Miridae). The other numerically dominant feeding type, predator, contains spiders and pteromalid wasps.

Over the season, total captures peaked in July after only five in June. The abundant families in September were also present in relatively large numbers in July, although the species groups changed. Of the remaining nine groups in July samples, which contained over 5% of the total captures, only two were present in September.

Herbivores were the most abundant feeding category in July and September. Predators were the second largest feeding category in all three sampling periods and consisted of different spider families and different species groups of Pteromalidae.

In aerial sweeps from juniper in the north slope pinyon-juniper habitat, 20 invertebrates in six species groups were captured in June (Table 3-7-290). Of this total, greater than one-half were a species group of plant bug (Miridae). Seven of the remaining eight invertebrates captured were spiders. The feeding types of these two abundant groups were herbivores and predators, contributing 60% and 35% of the total captures, respectively (Table 3-7-291).

Aerial sweeps from juniper foliage in July contained 25 invertebrates (Table 3-7-292). Curculionidae was the largest family with four individuals in one species group, although the parasitic wasp families taken as a group contained nearly one-half of the total captures and over one-half of the species groups. As a result of numerical dominance of Hymenoptera, the flower feeding types was most abundant (Table 3-7-293).

September results for sweep samples of juniper foliage at the north slope pinyon-juniper site show 29 invertebrates in 12 species groups (Table 3-7-294). Numerically dominant groups were Miridae and Eulophidae. Pteromalidae contained 17% of the total captures, giving a combined total of 65% for the three families. Feeding habits for the invertebrates captured included the herbivore, flower feeder and predator levels, each with over one-fourth of the total captures (Table 3-7-295).

Over the season, sweep captures from juniper at the north slope pinyon-juniper site were relatively constant, ranging from 20 in June to 29 in September. The immature Miridae, abundant in June, was not captured in July or September; however, the Miridae species group found in July was one of the most abundant groups in September.

Herbivore was the numerically dominant feeding category in June. Predators were relatively abundant in all periods and the most abundant category in July. In September, flower feeders were most common due primarily to parasitic wasp captures which were also common in July.

Malaise trap samples from the north slope pinyon-juniper habitat contained an estimated 7,488 invertebrates in June (Table 3-7-296). Only two groups, midges (Chironomidae) and stilletto flies (Therevidae), contained greater than 10% of the total captures, but seven other groups each contributed over 5% of the total captures. These included a group of unknown adult moth species, three fly families (Mycetophilidae, Sciaridae, and Cecidomyiidae), and three Hymenoptera families (Braconidae, Andrenidae, and Apidae).

Of the abundant groups, all but Therevidae and Cecidomyiidae were flower feeders, accounting for most of the 69% of total captures in this feeding category.

Malaise trap captures from this site in July contributed 1,020 invertebrates in 67 species groups (Table 3-7-298). Sixty-two percent of the total captures were contributed by five groups of insects including 22% unknown adult moths, 15% gall midges (Cecidomyiidae), 11% anthomyiid flies (Anthomyiidae), 8% Chironomidae and 6% sphecid wasps (Sphecidae). Diptera dominated capture numbers and contributed nearly one-half of the species groups.

Flower feeders made up 59.6% of all invertebrates captured (Table 3-7-299), with over one-half in the moth, chironomid, and sphecid wasp taxa. The 28.2% of the total captures in the unknown feeding category were almost entirely gall midges (Cecidomyiidae) and anthomyiid flies (Anthomyiidae).

Malaise trap captures from the north slope pinyon-juniper site in September consisted of 476 insects in 43 taxa (Table 3-7-300). A variety of Homoptera and three species groups of anthomyiid flies were common in Malaise samples. Other taxa included a group of moth species with 9% of the total captures, and two fly families, Cecidomyiidae and Tachinidae, with 9% and 7% of the captures respectively. Hymenoptera contributed more than 10% of the total captures.

Diptera and Hymenoptera species groups made up the remainder of the flower feeders. In the unknown feeding category, Anthomyiidae and Cecidomyiidae made up the majority of the captures. The Homoptera group dominated the herbivore feeding category.

Total estimated invertebrate captures went from 7,488 in June to 476 in September. Of the abundant groups in June, the gall midges (Cecidomyiidae) and one other species of midge (Chironomidae) were present and abundant in July. An additional six species were also present in June and July. The September samples also contained the same seven taxa as did June and July samples, with gall midges (Cecidomyiidae) still abundant. One species of anthomyiid fly which was relatively abundant in July was the most abundant species group in September samples.

Trap D-Vac samples were taken from sagebrush at the north slope pinyon-juniper site. In June, the five trap D-Vac samples taken from sagebrush at the north slope pinyon-juniper site contained an average of 2,809.4 invertebrates per cubic meter and a standard error of 2,133.6 (Tables 3-7-330 and 3-7-303). Twenty-two invertebrates in 12 species groups were taken, with only two species groups containing more than one individual (Table 3-7-304). Nearly one-half of the total captures were in one species group of Curculionidae. The remaining abundant group was larvae of the superfamily Tortricoidea (Lepidoptera), which contained two individuals.

Only two feeding categories, herbivore and predator, were captured at the north slope pinyon-juniper site in June (Table 3-7-305). The most abundant feeding category, herbivore, made up 83% of the total captures.

Sixteen invertebrates were captured by trap D-Vac of sagebrush at the north slope/pinyon-juniper site in July (Table 3-7- 331). Estimates of the number of invertebrates per cubic meter of plant for the five samples averaged 106.9 with a standard error of 26.2 (Tables 3-7-307).

Sixty-nine percent of the invertebrates captured from sagebrush were in three families: globular springtails (Sminthuridae), snout beetles (Curculionidae), and platygasterid wasps (Platygasteridae) (Table 3-7-308).

Fifty-six percent of the total captures were herbivores, most of which were springtails and snout beetles (Table 3-7-309). Flower feeders, the second most abundant feeding type, were composed mainly of members of the family Platygasteridae.

In September, invertebrates per cubic meter of sagebrush at the north slope pinyon-juniper habitat averaged 12,899.7 with a standard error of 6,900.2 (Table 3-7-332). Actual capture totals ranged from one to 11 invertebrates per plant. Three of the six species groups captured contributed 86% of the total captures, most of which were scale insects (Table 3-7-312). Snout beetles (Curculionidae) and stilletto fly larvae (Therevidae) were also abundant.

Two feeding types, herbivore and predator, were the only invertebrates captured in trap D-Vac samples from sagebrush at the north slope pinyon-juniper site (Table 3-7-313). The numerically dominant group, herbivores, contained 75% of the total captures, and included Coccoidea and Curculionidae. Stilletto fly larvae made up the bulk of the predator feeding category.

Over the summer, the estimated averages of invertebrates per cubic meter of sage went from 2,809 to 107 to 12,900, although actual captures varied only from 23 to 16 to 28.

Snout beetles (Curculionidae) were the only group abundant in all sampling periods, although the species groups contributing most to the families' members were different each sampling period.

d. <u>Sagebrush Habitat (Site 4)</u> - Beating and aerial sweeps were not taken at this site due to a limited tree stratum in this upland sagebrush habitat.

The largest number of invertebrates captured in pitfall samples in June was in the sagebrush habitat, where 5,313 invertebrates representing seven orders were taken (Table 3-7-333). Collembola demonstrated a high capture rate. Large numbers of individuals in the orders Acari, Araneida, and Hymenoptera were also captured.

The numerically dominant feeding category was saprovore (92%), a reflection of the large numbers of Collembola captured (Table 3-7-262). Two other feeding categories, omnivore and unknown, had over 1% of the total captures, and were made up exclusively of ants and mites, respectively.

July results showed 3,429 invertebrates in 10 orders captured in sagebrush pitfalls with a combined density of 48.24 individuals/m^2 (Table 3-7-334). Over 77% of the invertebrates captured in pitfalls were in the order Collembola.

The presence of 92.6% of the total captures in the feeding categories saprovore and omnivore reflects the dominance of Collembola and ants in the samples.

In September, total captures dropped to 422 invertebrates in nine orders (Table 3-7-335). Drastic reduction in Collembola captures is the primary reason for the reduction in captures over the previous two sampling periods. Acari and Hymenoptera were the most abundant orders captured, representing a combined total of 76.3% of the total invertebrates taken.

The combined density estimate for all orders used in calculations was 18.58 individuals per m^2.

Orthoptera (primarily crickets-Gryllidae) and Solpugida were numerous at this site relative to other sites. Feeding habit classifications for September pitfall captures in the sagebrush habitat (Table 3-7-266) indicate that the unknown category was the largest; it consisted entirely of mites. Other

categories were composed of members from a variety of orders with the exception of omnivore which contained only ants. The herbivore category contained the largest percentage of total captures at any site in September and contained specimens of Orthoptera, Coleoptera, and Lepidoptera.

Seasonal variation in the sagebrush habitat (Site 4) ground fauna was most apparent in the Collembola, which dropped from 4,856 captures in June to 2,658 in July and one in September (Tables 3-7-333, 3-7-334, and 3-7-335). This change in Collembola numbers is the primary factor influencing reductions in total captures and density estimates over the summer, both of which showed definite declines through September. Acari were captured in large numbers in June as well as during the later two sample periods at this site. There was an increase in total Acari captures each sample period, but the drastic seasonal increases or decreases in Acari numbers demonstrated at other sites did not occur in this upland sagebrush habitat.

The largest total capture of ants also occurred at the sagebrush site with over 850 specimens taken during the sampling season. Ants' avoidance of pitfall traps may be an indicator that even this total is a conservative estimate of the total population within the grid.

Captures of spiders in sagebrush habitat pitfalls remained constant over the summer. The largest total of sunspiders recorded at any site was recorded at this sagebrush site.

Trends in feeding habits over the summer are again closely tied to the trends in captures of Collembola and Acari, the two numerically dominant groups which made up almost exclusively the saprovore and unknown feeding categories, respectively. Consequently, when Collembola captures were high (in June and July), saprovore levels were high, and when Acari populations were high (September), corresponding high percentages of unknowns were recorded. In addition, omnivores made up a substantial portion of the captures of each period, due to the large number of ants taken within the grid.

The sagebrush habitat had by far the most densely populated litter samples in June, ranging from 35.0 to 1,427.4 invertebrates per kilogram of litter for the

five samples taken (Table 3-7-336). This is an average of 519.4 invertebrates per kilogram of litter with a standard error of 260.6 (Table 3-7-268). All five samples were taken under sagebrush. A total of 372 invertebrates were captured, of which 96 individuals were in the family Formicidae, which transported 64 pupae as they migrated through the litter in the Berlese funnel (Table 3-7-269). The presence of pupae is a good indication that the sample was taken over an ant nest, which is probably also true for one other of the five samples in which 74 specimens of the same ant species were taken. Other abundant groups in the samples were Collembola elongate-bodied springtails (Isotomidae) and mites (Acari).

The numerical dominance of ants (Formicidae) at the sagebrush site is the reason why 74% of the invertebrates in litter D-Vac samples from this site were categorized as omnivores (Table 3-7-270). The next largest feeding type (saprovores) was made up primarily of Collembola, the only other order taken in substantial numbers at this site in June.

Fifteen invertebrates were captured in five litter samples in the sagebrush habitat during July (Table 3-7-273). The number of invertebrates per kilogram of litter ranged from 0.0 to 23.1 for an average of 10.9 and a standard error of 4.0 (Table 3-7-337). Four samples were taken from litter near or under sagebrush, while one sample was taken in an open grassy area containing horse feces. This last sample contained no invertebrates resulting in a range of 4.6 to 23.1 invertebrates per kilogram of sagebrush litter. One thrip (Thysanoptera) and four adult winged midges (Diptera: Chironomidae) made up one-third of the invertebrates captured; neither is considered a typical litter-dweller. Six beetles (Coleoptera), consisting of three larvae and three adult darkling beetles (Tenebrionidae), and three mites (Acari) were also taken in litter samples in July. Flower-feeding invertebrates (principally thrips and midges) occurred in July litter samples at the sagebrush site (Table 3-7-274). The most abundant level, unknown, consisted of three mites and three unknown beetle larvae. The last level with more than one individual, saprovore, consisted of the darkling beetles (Tenebrionidae).

September data from the sagebrush habitat show 59 invertebrates captured in five litter samples (Table 3-7-338) giving an average of 90.9 invertebrates per kilogram of litter (Table 3-7-275). All samples were taken near or under sagebrush plants.

Mites (Acari) were the numerically dominant group captured in September litter samples and comprised 46% of the captures. Of the remaining families, only one, Chrysomelidae, contained more than 10 individuals (Table 3-7-277). As a result of the numerical dominance of mites, feeding habits are dominated by unknowns (55.9% of the total captures) (Table 3-7-278). Herbivore, the next most abundant feeding category, was made up primarily of leaf beetles (Chrysomelidae).

Over the sampling season, the average number of invertebrates per kilogram of litter at the sagebrush site dropped from 519.4 in June to 10.9 in July (Table 3-7-271) and rose to 90.9 in September (Table 3-7-275). Total captures ranged from 372 in June to 15 in July (Table 3-7-337) to 59 in September (Table 3-7-338). The seasonal variation in invertebrate numbers at this site is directly attributable to variations in captures of Collembola, Acari, and ants. The dominant group in June samples was ants, with two samples including a nest entrance, resulting in large captures of ants. The fact that placement of the cylinder in sampling happened to fall on a nest entrance in June and not in July and September is the major factor explaining the difference in captures over the season. Acari were present in substantial numbers in June and September but not in July, and Collembola made up more than 13% of the June captures, but were absent in July and September.

The sagebrush site had by far the largest number of darkling beetles captured, with one beetle per 2.43 m^2 of litter surface area. A species of ground beetle larvae (Carabidae) was present in all June and July, indicating the relatively long life cycle of the beetles in general and of a few families (Carabidae, Tenebrionidae) in particular in comparison to other orders.

The most obvious change in feeding habit categories in the sagebrush site litter samples over the season was the reduction in ant (omnivore) captures after June.

July samples were too small to provide reliable estimates of the trophic structure. The large number of mites (Acari) in September samples leads to the numerical dominance of the unknown feeding category.

Herbaceous sweep samples from the sagebrush habitat in June contained 22 invertebrates in 14 species groups (Table 3-7-279). This is the lowest capture total at any site in June, with only one family (Formicidae), having more than three individuals. Seven additional captures were from the order Hymenoptera, all of whichwere parasitic wasps.

Of the total captures, 45% were flower feeders, due primarily to the presence of parasitic wasps in the samples (Table 3-7-280). Omnivores (ants) and herbivores (Hemiptera, Homoptera, and Coleoptera) were also common in samples.

July samples from the sagebrush site contained 133 invertebrates in 35 species groups (Table 3-7-281). Half of the total captures were contributed by the families Cicadellidae and Miridae. Other relatively abundant groups captured were blister beetles (Meloidae), pteromalid wasps (Pteromalidae), ants, and an unknown beetle; all contributed between 5% and 10% of the total captures.

Three of the most abundant groups, Cicadellidae, Miridae, and Meloidae, are herbivores and contributed the bulk of the total captures in that feeding category (Table 3-7-282). The remaining relatively abundant feeding type, predator, was composed of individuals from the orders Araneida, Hymenoptera, and Diptera.

In September, the sagebrush habitat had the lowest total herbaceous sweep captures, with 77 invertebrates in 20 species groups (Table 3-7-283). Thirty of the individuals were in the spider family Salticidae (38% of total capture). Cicadellidae damsel bugs (Nabidae) and parasitic wasps (Hymenoptera) were also common in the samples.

Feeding habit results for the invertebrate captures in herbaceous sweeps from the sagebrush habitat in September show this site to be the only one where a majority of the invertebrates captured were predators (Table 3-7-284). Crab

spiders (Salticidae) made up the bulk of this feeding category, although damsel bugs (Nabridae) and pteromalid wasps (Pteromalidae) were also included. A variety of orders, including Hemiptera, Homoptera, and Coleoptera, contributed to the herbivore level which contained 24.7% of the total captures. Over the summer, total herbaceous sweep captures at the sagebrush site went from the lowest at all sites in June to a peak of 133 in July and 77 in September.

Overall results show relatively low numbers of species groups and total captures in herbaceous sweeps at the sagebrush site in comparison to other sites.

Malaise trap samples taken in the sagebrush habitat during June contained an estimated 4,736 invertebrates (Table 3-7-296). Seventy-nine percent of all captures at this site were contributed by five insect groups. Twenty-four percent of the total captures were midges (Chironomidae), 20% were dark-winged fungus gnats (Sciaridae) and 16% were gall midges (Cecidomyiidae), all in the order Diptera. Of the two remaining abundant groups, a variety of unknown adult moths contributed 14% of the captures and ichneumonid wasps (Ichneumonidae) contained 5%. Feeding habit results for the Malaise trap captures in June at the sagebrush site showed 74% flower feeders (Table 3-7-297).

July Malaise trap capture results from the sagebrush habitat revealed 2,576 invertebrates in 80 species groups (Table 3-7-298). Included in this sample were three groups which contained greater than 8% of the total numbers, Homoptera (24%), adult moths (18%), and Anthomyiidae (9%). Other important families of insects were midges (Chironomidae), gall midges (Cecidomyiidae), chloropid flies (Chloropidae), and ichneumonid wasps (Ichneumonidae), all with over 5% of the total captures. Less than 15% of the total captures were contributed by Hymenoptera; however, nearly one-half of the species groups were from this order, with most of these in the parasitic wasp families.

Flower feeders were the largest feeding category (45.5% of total captures) in July Malaise trap samples (Table 3-7-299). This category was made up primarily of Chironomidae, Chloropidae, adult moths, and Ichneumonidae. Of the invertebrate groups whose feeding habits are unknown, Anthomyiidae, Cecidomyiidae and an

unidentified adult beetle species were the most abundant. The remaining abundant feeding category, herbivore, was made up primarily of Homoptera.

In September, 968 invertebrates in 49 species groups were captured in the sagebrush habitat Malaise trap (Table 3-7-300). Sixty-six percent of the captures were contributed by five groups; Anthomyiidae was the largest group (29% of total captures). Two other dipteran families, Cecidomyiidae and Chloropidae, each contributed 6% of the total captures. The remaining abundant groups (adult moths and Homoptera) contained 13% and 12% of the total captures, respectively.

Over one-third of the species groups were contributed by Hymenoptera, although the abundance of this order was low, contributing less than 15% of the total captures.

The largest percentage of insects in the unknown feeding category (40.5%) was contributed primarily by Anthomyiidae and Cecidomyiidae (Table 3-7-301). Half of the flower feeders (36.8%) were adult moths and Chloropidae. A variety of Diptera and Hymenoptera was also among the flower feeders. The remaining abundant feeding type, herbivore (13.2% of the total captures), was almost exclusively Homoptera.

Over the summer, Malaise trap captures from the sagebrush habitat exhibited a steady decline from 4,736 invertebrates in June to 968 in September.

Of the five trap D-Vac samples taken from sagebrush in June, the average number of invertebrates per cubic meter of sagebrush was 235.8 with a standard error of 46.4 (Table 3-7-339 and 3-7-303). Of the 53 invertebrates in 26 species groups, five families contained 54% of the captures (Table 3-7-304). These consisted of an unknown Hemiptera nymph, delphacid planthoppers (Delphacidae), lady-bird beetles (Coccinellidae), Noctuidae larvae (Lepidoptera), and Tortricoidea larvae.

Of the abudant groups captured in trap D-Vac samples at the sagebrush site in June, all but Coccinellidae were herbivores (Table 3-7-305).

Results of trap D-Vac sampling of sagebrush in July show an average for five samples of 299.0 invertebrates per cubic meter of sagebrush and a standard error of 204.8 (Tables 3-7-340 and 3-7-307).

Twenty-six invertebrates were captured at the sagebrush site during July sampling (Table 3-7-308), with half this number represented by snout beetles (Curculionidae) and leafhoppers (Cicadellidae). Other numerically important groups included thrips (Thysanoptera) and ladybird beetles (Coccinellidae). The 26 invertebrates captured represented 13 species groups, with five of these in the family Cicadellidae.

Twenty of the 26 invertebrates captured were herbivores, making this the dominant feeding category in July with 77% of the total captures (Table 3-7-309). Most of the remaining invertebrates were ladybird beetles (Coccinellidae), which are predators.

In September, estimates of the number of invertebrates per cubic meter of sagebrush in the sagebrush habitat averaged 6,931.7 with a standard error of 4,913.6 (Tables 3-7-341 and 3-7-311).

Fourteen invertebrates were captured in 11 species groups, of which only three families had more than one individual: Cicadellidae (five leafhoppers), Curculionidae (two snout beetles), and Hymenoptera (two unknown wasps) (Table 3-7-312). The majority of the invertebrates captured were herbivores (78.6% of the total captures) including Cicadellidae and Curculionidae (Table 3-7-313).

Density estimates ranged from 235.8 to 6,931.7 invertebrates per cubic meter of sagebrush over the sampling period. Total captures ranged from 41 in June to 14 in September. Of the six families in which five or more individuals were captured in June, only one beetle family (Coccinellidae) was present in both June and July samples. Species groups of Curculionidae, the most abundant family in July samples, were also present in June and September samples, with different groups each period. Herbivores were the dominant feeding category in all sampling periods.

e. Mixed Brush Habitat (Site 5) - Pitfall litter D-Vac, trap D-Vac, herbaceous sweep, and Malaise trap samples were taken at the mixed brush site in June, July and September of 1975.

Pitfall results for June at Site 5 reveal a total of 258 captures in 9 invertebrate orders (Table 3-7-342); 80% of these captures were used in density calculations yielding an estimate of 3.99 invertebrates per m^2. Ants were the most abundant invertebrate group captured (30% of total captures).

Four feeding categories were identified in pitfall samples; omnivore (30% of total captures), saprovore (23% of total captures), unknown (22% of total captures), and predator (21% of total captures) (Table 3-7-262).

A total of 705 invertebrates in 11 orders was captured in July pitfall samples at the mixed brush site. Thysanura and Hymenoptera were abundant, accounting for almost 70% of the total captures (Table 3-7-343). Coleoptera total captures were high relative to other sites. Over half of the Coleopterans captured were in the family Tenebrionidae. The numerically dominant order Hymenoptera, consisting entirely of ants, contained 32.6% of the total invertebrates captured. The two remaining abundant orders were Acari and Araneida, with 14.33% and 6.67% of the total captures, respectively.

Two dominant feeding categories for ground-dwelling invertebrates were identified in July: saprovore (40.7% of total captures) and omnivore (32.6% of total captures) (Table 3-7-264). The omnivore category contained ants only; however, the saprovore level included the orders Thysanura, Collembola, Orthoptera, Psocoptera, and Phalangida. Acari made up most of the unknown feeding category.

In September, 225 invertebrates in 10 orders were captured by pitfall in the mixed brush site (Table 3-7-344). Density estimates totalled 5.16 invertebrates per m^2. Acari accounted for 28.89% of the total invertebrates captured.

Acari accounted for the majority of the invertebrates in the unknown category, spiders for most of the predators, and ants for all of the omnivores. Thysanura, Collembola, and Orthoptera comprised the saprovore feeding category (Table 3-7-266).

July pitfall samples from the mixed brush site had the highest total captures but the lowest density estimates. In both June and September samples, density estimates were based on greater than 70% of the total captures, but on only 35% of the July captures. Orders with largest total captures varied each sampling period with ants and Thysanura the most numerous insects taken in pitfalls over the season.

Saprovore, omnivore, predator and unknown feeding categories all contained relatively large percentages of the total captures each sampling period.

Results from litter samples taken in the mixed brush habitat show a range of 26.0 to 263.7 invertebrates per kilogram of litter (Table 3-7-345) with an average for the mixed brush site of 126.9 and a standard error of 45.2 (Table 3-7-268). Sample numbers 76, 155, and 156 were taken under large clumps of serviceberry and snowberry in deeper litter than the other samples and contained 122.8, 263.7, and 186.3 invertebrates per kilogram litter, respectively. The remaining two samples (77 and 80), containing 26.0 and 35.4 invertebrates per kilogram of litter respectively, were taken in more open areas. Ants contributed greater than 30% of the total captures in June. Elongate-bodied springtails contributed 19% of the total captures, unknown beetle larvae 6%, pseudoscorpions 7%, and mites 13% of the total captures (Table 3-7-270). Of these groups, the springtails, beetle larvae and pseudoscorpions were found primarily in the deeper litter under serviceberry and snowberry.

Ants were the most abundant family captured at the mixed brush site, which accounted for the high percentage of omnivores tallied. Other abundant groups and their feeding categories at this site were springtails (Entomobryidae) in the saprovore category and mites (Acari) in the unknown. The predator category consisted of a variety of Coleoptera and Araneida.

A total of 365 invertebrates was captured in July in the mixed brush litter. Numbers of invertebrates per kilogram of litter ranged from 51.4 to 228.4 (Table 3-7-346) for an average of 103.5 and a standard error of 33.4 (Table 3-7-271). Variations in the litter type showed some correlation with the variation in invertebrate numbers. Sample numbers 180 and 181 were taken in deep litter under large serviceberry clumps and contained 228.4 and 118.0 invertebrates

per kilogram of litter, respectively. Sample numbers 178 and 179 were taken in more open areas of serviceberry mixed with snowberry and contained substantially fewer invertebrates (59.2 and 51.4). The last sample (number 182) was from sage litter (Table 3-7-346) and contained 60.6 invertebrates per kilogram liter.

Acari was by far the numerically dominant order, containing 59% of all invertebrates captured (Table 3-7-273). Of the 215 mites sampled, 151 were from the serviceberry litter and 48 from the sage litter. Other abundant groups included elongate-bodied springtails (Entomobryidae), beetle larvae (Coleoptera), ants (Hymenoptera: Formicidae), pseudoscorpions (Chelonethida), and hunting spiders (Gnaphosidae). Springtails were found primarily in the deep serviceberry litter, and the remaining abundant groups were evenly distributed among all samples.

Feeding categories were comprised of 256 unknowns (70.1% of total captures) of which 215 were mites (Acari); the remainder were a combination of unidentified Hemiptera, leafhoppers (Cicadellidae), and unknown beetle larvae (Table 3-7-270). The 49 saprovores (13.4% of total captures) were made up primarily of Collembola, but Psocoptera and Tenebrionidae were also present. The predator level included a variety of taxa with pseudoscorpions (Chelonethida) the most abundant, followed by Araneida, rove beetles (Staphylinidae), stilletto fly larvae (Therevidae), and a centipede (Geophilomorpha).

September litter samples from the mixed brush habitat contained 630 invertebrates in five samples (Table 3-7-347). The number of invertebrates per kilogram of litter ranged from 84.3 to 1,685.3 (Table 3-7-347) for an average of 687.9 and a standard error of 279.5 (Table 3-7-275). Six hundred thirty invertebrates were captured in September litter samples at the mixed brush site. Mites (Acari) accounted for 79% of all captures. Other groups with significantly large captures included elongate-bodied springtails (Entomobryidae), beetle larvae (Coleoptera), pseudoscorpions (Chelonethida), and dictynid spiders (Araneida: Dyctinidae).

Over 83% of the total captures were in the unknown feeding category, most of which were mites. Of the remaining feeding categories, only two, saprovore and

predator, contained more than 5% of the total captures (Table 3-7-278). Fifty-eight of the 60 saprovores were Collembola, and more than two-thirds of the predators were spiders.

Over the sampling season, the average number of invertebrates per kilogram of litter from the mixed brush habitat ranged from 126.9 in June to 103.5 in July to 687.9 in September, giving Site 5 the largest total estimated average number per kilogram litter for the three sampling periods. The average number of invertebrates in the deep serviceberry litter samples went from less than 125 in June to between 118 and 228 in July and between 500 and 1,700 in September. In snowberry-serviceberry litter, which was generally much shallower in depth, averages over the summer varied from nearly 200 in June to less than 60 in July to more than 300 in September. Sagebrush litter showed less variation in invertebrate numbers; averages of 35.4 in June to 84.3 in September were recorded.

Eight species groups of invertebrates were found in both the June and July samples at the mixed brush site. This includes the long-lived pseudoscorpions (Chelonethida), rove beetles (Staphylinidae), and a group of immature beetles (Coleoptera). Four species of ants (Hymenoptera: Formicidae) and one species group of Collembola were also present in both sampling periods. The last group present in both early sampling periods was a species group of fly larvae (Diptera), which are generally short-lived and can be expected to become adults at some time during the summer; this may explain their absence from litter samples in September.

Of the above groups, only pseudoscorpions, Collembola, and immature beetles were also present in September at this site. In addition, one species group of centipede (Geophilomorpha), one ant species, and a ground beetle were collected in June and September indicating they are also present throughout the summer.

Feeding habits of the litter invertebrate fauna at the mixed brush site reflect the relative abundance of mites in the July and September samples with percentage of total captures in the unknown category over 70 in both sampling periods. In June, ants were taken in large numbers compared to other periods and comprise the major portion of the omnivore feeding category.

Herbaceous sweep samples from the mixed brush habitat in June show a total of 50 invertebrate captures in 26 species groups (Table 3-7-279). Plant bugs (Miridae), leaf miner flies (Agromyzidae) and ants (Formicidae) were common in the samples. Only one other family, checkered beetles (Cleridae), contained 10% or more of the total captures. Of the 26 species groups captured, nearly one half (11) were in the order Hymenoptera; five of these were parasitic wasps.

Herbivores comprised 48% of the invertebrates captured at the mixed brush site in June. Half of these were plant bugs (Miridae) and checkered beetles (Cleridae). Flower feeders, the second largest feeding category, contained seven families, the most abundant of which was Agromyzidae. As adults, these flies feed on nectar, but as larvae they are herbaceous leaf miners.

A total of 439 invertebrates in 53 species groups was recorded for herbaceous sweep samples in July (Table 3-7-281). The numerically dominant family was Aphididae, with 142 individuals (32% of the total captured). Miridae, Cicadellidae, Acari, Formicidae, Curculionidae, and Cleridae were also present in the samples.

Most of the 66.1% of the total captures in the herbivore feeding category at this site in September are accounted for by the plant feeding families listed above as abundant. Of these, the majority (Aphididae, Miridae, and Cicadellidae) are plant sap feeders; the remaining families (Curculionidae and Cleridae) are plant tissue feeders.

In September, the total captures from the mixed brush habitat increased to 1,615 individuals per 100 sweeps, contributed by 62 species groups. This is by far the largest total at any site in any sampling period and is comprised primarily of one aphid family (Aphididae) which contributed 80% of the total. Other relatively abundant groups included thrips (Thysanoptera), plant bugs (Miridae) and pteromalid wasps (Ptermalidae). Of the 300 non-aphid invertebrates captured, one-third were parasitic wasps in the order Hymenoptera. Herbivores comprised 88.9% of the total captures; the majority of these were aphids (Table 3-7-284).

Total invertebrate captures peaked in September herbaceous sweep samples from the mixed brush habitat due primarily to the rapid rise in aphid populations. Numbers of species groups also peaked in September. In July and September, aphids were by far the numerically dominant group in captures, although none were encountered in June samples. The mixed brush habitat herbaceous sweep results show herbivores as the numerically dominant invertebrates during all sampling periods. In June this category was composed of a variety of Hemiptera, Homoptera, and Coleoptera, while in July and September the herbivore captures were dominated numerically by aphids.

Malaise trap captures from the mixed brush habitat contained 6,528 invertebrates in June (Table 3-7-296). Sixty-two percent of the total captures were contributed by four families of flies (Diptera), with Chironomidae the most abundant (39% of total captures) followed by lonchaeid flies (Lonchaeidae; 8% of total captures), Cecidomyiidae (8% of total captures), and Sciaridae (7% of total captures).

More than one-half of the flower feeders captured in the mixed brush habitat in June were chironomids, with two additional abundant taxa, Sciaridae and adult moths, also contributing substantial numbers (Table 3-7-297). Sixteen of the 19% unknowns were members of the families Lonchaeidae and Cecidomyiidae. A total of 1,592 invertebrates was captured in the Malaise trap at the mixed brush site in July (Table 3-7-298). Adult moths, Chironomidae, and Anthomyiidae were the most abundant groups recorded. Flower feeders contributed 54.8% of the total captures (Table 3-7-299); two-thirds of these were adult moths, Chironomidae, and Ichneumonidae.

The second most abundant feeding category, unknowns, contained 26.4% of the total captures, with most of these in the dipteran families Anthomyiidae and Lonchaeidae. Two other feeding categories, saprovore and predator, were made up primarily of the families Sepsidae and Ptermalidae, respectively.

In September mixed brush Malaise trap samples, 856 invertebrates in 42 species groups were recorded (Table 3-7-298). The most abundant groups were adult moths, Chironomidae, and Anthomyiidae. Three families contributed greater than

5% of the total captures, including Cecidomyiidae, Chloropidae, and braconid wasps (Braconidae). Flower feeders were the dominant feeding category followed by unknowns (Table 3-7-299).

Over the sampling season, there was a decline in total invertebrate numbers from June to September. Thirteen of the 31 species groups present in June were also present in July, including both species groups of Chironomidae, the lonchaeid fly species, and gall midge (Cecidomyiidae).

Two plant species were sampled by trap D-Vac at the mixed brush site; serviceberry (Amelanchier utahensis) (Site 5A), and mountain snowberry (Symphoricarpos oreophilus) (Site 5B). Five plants of each species were vacuumed. Results of sampling serviceberry gave an average of 733.9 invertebrates per cubic meter with a standard error of 440.0 (Table 3-7-303) in June. Results for the five plants sampled indicate a relatively constant number of invertebrates from each plant, but a variation in the size of the plants (Table 3-7-348). Twenty-four invertebrates in 13 species groups were captured (Table 3-7-304). Two groups, snout beetles (Curculionidae) and catworm larvae (Noctuidae), were the most abundant of the total captures.

Eighty-seven percent of the captures, including both abundant families, were herbivores (Table 3-7-305). Invertebrate density estimates from serviceberry at the mixed brush site in July averaged 133.9 with a standard error of 61.8 (Tables 3-7-349 and 3-7-307). Thirteen invertebrates in 12 species groups were captured from serviceberry in July. Ten of the 13 invertebrates captured were herbivores (Table 3-7-309).

In September, estimates of invertebrate numbers per cubic meter of serviceberry at Site 5A ranged from 351.8 to 8,269.0 (Table 3-7-350), for an average of 2,698.4 and a standard deviation of 1,467.5 (Tables 3-7-311). Plant bugs, scale insects, leafhoppers and aphids were abundant in samples. Thysanoptera and a group of unknown Lepidoptera larvae were also captured (Table 3-7-312). All of the groups considered abundant in the September trap D-Vac samples from serviceberry were herbivores (Table 3-7-313). Over the season, the estimated density of invertebrates per cubic meter of serviceberry went from 733 in June

to 134 in July to 2,698 in September. Herbivores were numerically dominant on serviceberry during all sampling periods.

Snowberry samples yielded an average of 732.3 invertebrates per cubic meter with a standard error of 251.6 in June (Tables 3-7-351 and 3-7-303).

Thirty-seven individuals in 21 species groups were captured in trap D-Vac samples from snowberry at Site 5B in June (Table 3-7-304). Of this total, snout beetles (Curculionidae) were the most abundant group (22% of total captures) followed by Cicadellidae (14% of total captures), stilletto fly larvae (Therevidae) and Thysanoptera (11% of total captures each). Seventy percent of the captures were herbivores, including all of the abundant taxa except Therevidae. Therevidae has predacious larvae, and these made up all of the predator feeding category in the samples (Table 3-7-305).

In samples from snowberry at Site 5B in July, results showed an average of 344.9 invertebrates per cubic meter and a standard error of 205.0 (Tables 3-7-352 and 3-7-307). Herbivores were the most abundant feeding category with Curculionidae and a variety of other species groups making up 69% of the total captures (Table 3-7-309). The only other feeding category with more than one invertebrate was the flower feeder category, with Chironomidae the only family included.

In September, 90 invertebrates were captured in five samples taken from snowberry at Site 5B, yielding a density estimate of 2,118.6 individuals per cubic meter (Tables 3-7-353 and 3-7-311). Of the 90 individuals taken, 47% were in two groups: globular springtails (Smithuridae), and thrips (Thysanoptera) (Table 3-7-312). The rest were distributed among 30 other species groups in 17 families. In both abundant families, individuals were taken in all samples.

Over the sampling season, density estimates and actual captures of invertebrates on snowberry closely paralleled the results of samples from serviceberry, being low in July and very high in September.

4. <u>Discussion</u> - Several different methods were used to sample invertebrates at five vegetation types in June, July, and September of 1975. In each of the

vegetation types (greasewood-sagebrush, south slope pinyon-juniper, north slope pinyon-juniper, sagebrush, and mixed brush) samples were taken by pitfall, litter D-Vac, herbaceous sweep, and Malaise trap methods. Trap D-Vac samples were also taken from one or more of the dominant shrub species at each site. In greasewood-sagebrush and pinyon-juniper on north and south slopes, aerial sweeps and beating samples were also taken.

The following discussion will establish which invertebrate groups are numerically important within each vegetation type. Importance is based on a group's potential for influencing the health of biomass production of the dominant vegetation species. Groups peculiar to a specific habitat type and groups which are important in controlling invertebrate population fluctuations within each of the vegetation types will also be discussed.

Seasonal population trends of the important invertebrate groups and the possible effects of abiotic factors on these trends shall be presented when recognized. Comparisons of invertebrate groups within vegetatively similar sites and of the important aspects of invertebrate ecology over all sites will be emphasized.

The ground dwelling fauna in greasewood-sagebrush contained one order, Phalangida, which was captured in abundance at this site only. All of the captures were in pitfalls, indicating that the species of this order are probably not true litter dwellers, but were captured on the ground while searching for food or water. In order for this group to be active, there must be a continual source of free water for drinking (Savory, 1962). This water source was probably available at the greasewood-sagebrush site in June as a large number of Phalangida were captured at that time. In later sampling periods they were not captured frequently, leading to the assumption that their activity was limited by the lack of available free water. The assumption that free water was less frequent in July and September was substantiated by daily visual observations of the amount of moisture in the pitfall cups. In June the presence of moisture in the cups was apparent nearly every day while in July it occurred only twice in the 10-day period. In September, brief showers occurred frequently; however, the cool night temperatures probably precluded most nocturnal activity by Phalangida, and by early morning the vegetation and pitfall cups were already dry.

Mites (Acari) were also abundant in samples from greasewood sagebrush, with large increases in captures as the season progressed. Most of the mite captures were hard-bodied Orbatid mites whose tolerance of extreme heat and dessication varies with the species (Butcher, Snider, and Snider, 1971). It appears that the species found in this habitat are relatively tolerant to heat and dessication and can survive and reproduce under conditions of decreasing soil moisture. If in fact soil moisture was reduced over the season, then competition for food within the litter layer may also have decreased over the season as a result of reductions in numbers of other litter inhabiting groups, such as Collembola, which require moisture for feeding (Ford, 1937). This may be one of the factors contributing to the substantial increase in Acari captures over the sampling season. One other order, Psocoptera, was the only other order of ground dwellers which was abundant only in the greasewood-sagebrush habitat. Psocoptera probably avoided the presumed dry conditions by limiting their activities to the litter where they were captured in abundance in September. During July sampling, however, they were captured in large numbers in pitfalls.

The invertebrate fauna which inhabited the vegetation in greasewood-sagebrush can be divided into two groups based on whether they were found on the dominant shrub species or on the herbaceous vegetation.

Two families captured from the herbaceous vegetation appeared to be of importance due to their high total captures. In July, Chloropidae made up the bulk of the sweep sample. It is possible that this family, which was abundant at the greasewood-sagebrush site only, was the major herbivore group feeding on rye grass. The larvae of this family feed in the culms of grasses, and can reduce the production of grass species and the formation of flowering heads, thereby reducing seed production (Sabrosky, 1936; Blocker, 1969).

September sweep samples were dominated by a species of seed bug (Lygaeidae). It is suspected that the abundance of this group was also related to the large amounts of rye grass found in the understory of the greasewood-sagebrush site. Prior to the September sampling period, the nymphs of this family were probably feeding on the seeds of rye grass. The appearance of the adult stage coincides with drying up of the seeds when the grains no longer provide a succulent source of food. It appears that the sample was taken as the adults prepared to migrate to other sources of food, or find suitable places for overwintering.

Sampling of the two dominant shrub species in the greasewood-sagebrush habitat, sagebrush and rabbitbrush, revealed that total invertebrate captures were more abundant from these plant species than from shrub species sampled in other vegetation types. In samples from rabbitbrush, three herbivore taxa were common during different sampling periods. Thysanoptera, Anthicidae, and Cleridae were all found on the flowering heads of the plants sampled. Thysanoptera and Anthicidae are feeders on flower parts, and their abundance could have an effect on seed production. Both are known pests of range plants in grassland areas (Blocker, 1969; Brues, 1946). Cleridae was also considered a herbivore, although most members of the family are predators. The family is not known as a pest, although visual observations indicated that they were present in large numbers in the flowering heads of rabbitbrush in July. If they were feeding on flower parts, they could have a substantial effect on seed production.

Samples from sagebrush revealed a number of herbivorous families which were abundant throughout the season. Aphididae was probably the most important of these families in terms of the effects of their feeding on sagebrush. This family had large total captures in July and September, with the same species group abundant in each period. Their relative abundance later in the season is characteristic of aphid populations which reproduce in large numbers with several to many generations per season (Borror and DeLong, 1971). The presence and abundance of aphids may be the reason for relatively large numbers of ladybird beetles (Coccinellidae) in the captures. This group is well known as predators of aphids although members of the family feed on many other insects as well (Borror and DeLong, 1971). Cocinellidae was only part of an abundant predator fauna captured at this site.

Of the fauna captured in Malaise traps in greasewood-sagebrush, two families, Cecidomyiidae (gall midges) and Anthomyiidae, were very abundant and were probably the most significant insect groups in terms of their effect on the vegetation in the greasewood-sagebrush habitat. Many of the gall midges are considered pests because of their means of reproduction, which involves oviposition into the tissue of the plant hose species and results in gall formation. Formation of these galls can cause disruption of normal plant growth and, in some cases, death of the plant tissue past the point of gall

formation. Many plant species, including sagebrush, are hosts for a variety of gall makers, and in some instances this has led to weakening or death of the plants involved (Felt, 1965).

Several species groups of Anthomyiidae were abundant in July and September at all sites. Although little is known of their life histories, they must be considered important because of their large numbers. Anthomyiidae larvae have a variety of feeding habits including herbivore and dung feeding. Based on morphological characteristics, the groups sampled were not herbivores as larvae, but dung feeders. If this is the case, then this group probably plays an important role in nutrient recycling in the study area by breaking down detritus.

A group of wasp families with parasitoid larvae was captured in all strata at the greasewood-sagebrush site. There was a variety of species groups present in all samples throughout the season, with relatively large total numbers in most cases. The value of this group is well known in agriculture because of attempts to use certain species as a form of biological control of economic pest insects (Borror and DeLong, 1971). In a natural habitat these groups are beneficial in providing a source of control for rapid increases in populations of many groups of herbivorous insects. The host specificity of these parasitic wasp larvae (Borror and DeLong, 1971) combined with the fact that a wide diversity of parasitic wasp families and species groups exists in the study area indicates that this group may exert a considerable influence on the populations of a wide variety of herbivorous insects.

Dominant orders in the ground-dwelling fauna of the south slope/pinyon-juniper habitat were Collembola and Acari. In June, Collembola were captured in large numbers in pitfalls, but were absent from litter samples. Collembola require a moist environment to escape dessication and, more importantly, for feeding (Ford, 1937), indicating that moisture levels on the ground surface were probably high in June at some point during the day. Pitfall captures of Collembola probably occurred at night when cool temperatures and higher humidities existed. During the day, Collembola must retreat to protected microhabitats where humidities remain high, and it would seem that these conditions would exist in the thick litter layers under pinyon and juniper trees.

In July, Collembola were not collected in pitfalls but were abundant in litter. During this period moisture was probably not sufficient on the ground surface for Collembola to feed, and as a result they were found only in the litter. In contrast, Acari were not captured in large numbers until July and August, when they were the most abundant invertebrates. This increase in mites over the season was characteristic of all sites and was interpreted in discussions of trends in Acari captures for the greasewood-sagebrush site. It appears that the same reasoning for the existance of these trends applies to the Acari populations at this south slope pinyon-juniper site. The relatively low numbers of mites in June might be a result of the fact that most mite species have a relatively narrow range of temperatures in which they are active (Butcher, et al., 1971). During June soil temperatures were quite low for most of the day, reaching 15^{0}C only for short periods. In July, soil temperatures usually reached 15^{0}C by the time the first readings were taken in the morning. It is suspected that with the increase in length of time in which higher soil temperatures occur during the day, Acari populations were more active and increases in the population occurred.

The type of litter sampled also had a bearing on the numbers of invertebrates captured in all sample periods. Samples from litter under pinyon pine contained the majority of the captures in July, while juniper litter samples for the same sample period contained few invertebrates, none of which were Collembola. As the litter layer under both tree species was thick and somewhat moist, it is possible that the juniper litter itself inhibited insect colonization to some degree. The presence of phenols in the tissue of juniper trees is known to prevent many herbaceous insects from attacking the foliage of juniper (Personal communication, T.O. Thatcher, 1975, Utah State University), and this may also be the reason that the juniper litter was relatively free of insects.

Scorpions (Scorpionida) were found exclusively in the ground-dwelling fauna of south slope/pinyon-juniper habitat. Three individuals were captured over the summer within the pitfall grid boundaries, resulting in a density of 0.03 scorpions per m^2, a relatively high density for this large, mobile predator group. Air and soil temperatures were highest at this site relative to other

sites throughout the sampling season, and this may be the reason for their presence at this site, where the most xeric conditions existed.

Ants were captured in relatively large numbers at this site in July and September pitfall samples. They were observed actively moving about in the grid in the early morning but had disappeared by mid-day. This demonstrates a behavioral adaptation which is widespread in this family. The ants react to high temperatures by foraging earlier or later in the day when it is cooler.

Low herbaceous sweep sample totals reflect the sparse ground layer vegetation in the south slope/pinyon-juniper habitat. The dominant group as the season progressed was Aphididae, which had relatively large total captures in September. Ants were also common in all periods and in September were observed tending aphids on nearly every Leptodactylon sp. plant inspected in the vicinity of the grid.

Results of sampling shadscale revealed this plant species had the least number of associated herbivorous insects throughout the season. The relative thickness and hardness of the leaves as well as high salt concentration in the plant tissue may be a factor in the reduced numbers and variety of herbivorous insects on shadscale relative to other plant species sampled. In June, a group of lepidoptera larvae in the superfamily Tortricoidea were abundant, presumably feeding on the foliage. By July they were no longer present, and it is suspected that they had moved to the litter for pupation and later emerged as adults. This may in part explain the large number of adult moths present in July Malaise trap samples.

Scale insects were also abundant in June and September, but absent in July. The immature life-stage in which this group was captured was readily removed from the plants by vacuuming. The adult females, however, are stationary and fixed to the plant branches, and cannot be readily removed, which may explain why no scale insects were captured in July.

Chironomidae was the most abundant group collected in samples from shadscale in July. It appeared as though adult chironomidae were attracted to shadscale by a concentrated plant sap produced by the plant in response to moisture stress.

It is possible that this substance may have been of some nutritional value to the adult Chironomidae. Other shrub species sampled in the same vicinity as the shadscale did not harbor chironomidae in large numbers.

Samples from pinyon pine contained few invertebrates in June, but in July and September a large number of Miridae was collected. This family feeds primarily on plant sap and is not always host plant species-specific (Borror and DeLong, 1971); however, their abundance in pinyon pine indicated that they may have been feeding on the foliage. Keen (1952) lists no Miridae species as economically important pests of pinyon pine.

Samples from juniper were dominated numerically by what appeared to be the same species group of Miridae captured on pinyon pine. This group was present throughout the sampling season.

Active flying groups captured in the south slope/pinyon-juniper habitat were dominated numerically by adult moths, Cecidomyiidae, and Anthomyiidae. All are herbivores or saprovores, either as larvae or adults, and where their numbers are large they can have serious effects on the vegetation upon which they feed.

The remaining group taken in abundance at the south slope/pinyon-juniper site was a species group of Scarabaeidae. Larvae of this family have a variety of feeding habits including herbivore and dung feeding.

Ground-dwelling invertebrates in the north slope/pinyon-juniper habitat exhibited many of the same characteristics as those captured in the south slope/pinyon-juniper habitat. In June, Collembola were abundant in pitfalls and absent in litter samples. Possible explainations were presented in the preceding discussion of the ground-dwelling fauna at the south slope/pinyon-juniper habitat. In July, however, results for the two pinyon-juniper sites differed in that Collembola were present in both pitfall and litter samples at the north slope/pinyon-juniper site. Collembola presence in pitfalls may be an indication that some moisture was available on the surface to prevent dessication and facilitate feeding.

Increased tree cover and less direct sunlight at the north slope/pinyon-juniper site relative to the south slope site may have been partially responsible for this condition. In September, Collembola were present only in the litter samples and had substantially decreased in numbers.

It appears, then, that Collembola populations were actively feeding and reproducing for longer periods of time during the summer in the north slope/pinyon-juniper habitat than in the south slope habitat, therefore increasing consumption of dead plant material in the former habitat due to the longer time period of active feeding. Less obvious is the possibility that Collembola feeding on fungal hyphae could keep the fungi at maximum production, thereby indirectly increasing the amount of dead plant matter broken down (Christiansen, 1964).

Acari captures in the north slope/pinyon-juniper habitat exhibited the same trends in total numbers (for pitfall and litter D-Vac samples) as Acari populations at the south slope/pinyon-juniper site. Suggested explanations already presented in the discussion of trends in Acari populations in the greasewood-sagebrush habitat are applicable to the Acari fauna at this site.

Low capture totals in sweep samples from the ground layer vegetation at the north slope/pinyon-juniper site were indicative of the small amount of vegetation in the understory. Only one group of herbivores, Psyllidae, was abundant in any of the sampling periods.

Visual observations of pinyon pine in the north slope/pinyon-juniper habitat indicated that ants were actively foraging in the foliage of most trees surveyed in June. Sweep and beating sample results supported this observation in that ants were the abundant group captured in June samples. No likely prey species or aphid populations were present in the samples at that time, however, indicating that the ants were probably feeding on vegetation rather than aphid waste products at that time. Ants observed in columns moving down the trees were not carrying visible food particles, leading to the conclusion that they were probably feeding on plant sap. In July, the Miridae found in pinyon pine

in the south slope/pinyon-juniper habitat were also abundant in pinyon pine at the north slope/pinyon-juniper site. In addition, a few aphididae were captured which indicated the beginning of a buildup in population of this group, which peaked in abundance in September. As stated in the discussion of Aphididae captured from shrub species at the greasewood sagebrush habitat, members of this family are well known as economic pests on a variety of agricultural and rangeland plants. Aphids can also be economic pests of most tree species including the pines (Keen, 1952), although evidence of tree death due to Aphididae attack is an uncommon occurrance.

Samples from juniper foliage contained only one abundant herbivore group, the Miridae, which was also taken in large numbers from juniper in the south slope/pinyon-juniper habitat.

A comparison of results for pinyon and juniper at both of the sites where the two species of trees are dominant indicated that overall there were more species groups of herbivores captured from foliage of pinyon than from juniper. It is possible that this was a result of the phenols present in juniper as discussed previously for litter samples at the north slope/pinyon-juniper habitat.

June Malaise trap results for the north slope pinyon-juniper habitat revealed relatively large numbers of dipterans, including members of the family Cecidomyiidae. The effect of this family on vegetation was discussed previously.

Two other families which contained relatively large total captures in June were Sciaridae and Mycetophilidae, families whose larvae are fungus feeders. The thick litter layer under pinyon pine contained large amounts of fungae hyphae, and it is possible that these families developed and emerged from this microhabitat. The remaining abundant group included two families of bees, Aphidae and Andrenidae. These two families are members of the superfamily of bees which are important as pollinators in nearly any vegetation type. Their presence in this north slope/pinyon-juniper vegetation type, where the understory contained few insect-pollinated plant species, was unusual in view of the fact that they collect nectar and pollen. It is possible that the abundance of dead

trees in this habitat offered the best choice of nest locations where a colony of bees could establish itself and still be within flying distance of areas such as sagebrush and rabbitbrush which provide a greater diversity of food plants. Reaching areas where food sources were more abundant would not be difficult for members of these families, which are known to range up to three miles in normal daily foraging activity (Dadant et al., 1975).

Most of the abundant groups found on sagebrush at the greasewood-sagebrush site were not present in trap D-Vac samples from sagebrush in the pinyon-juniper habitat. The plants sampled were in most cases relatively free of attack by herbivorous insects. One exception was a species group of Curculionidae which was found in relatively large numbers during all sampling periods. Most of the species in this family are monophagous or limited to a few plant hosts (Arnett, 1973), and in many cases larval development occurs within the stems of the plant. However, the larvae and adults do not always feed on the same plant species. The relatively low numbers of captures per plant may indicate that the damage to sagebrush is not substantial, although if the larvae were feeding within the stems, cumulative damage over several seasons could result.

The last group which showed potential for herbivorous damage of sage at this site was a species of immature scale (superfamily Coccoidea). On one plant sampled in September, over 140 individuals -- a relative large number for a single plant -- were captured. The damage potential for this group is well documented for many herbaceous plant species (Borror and DeLong, 1971).

Death of plants caused by scale insect attack is not common. Most damage is usually caused by a general weakening of the plant over a number of seasons.

When all sampling types used at the north slope/pinyon-juniper habitat over the season are considered, two groups appear to be the most important in terms of numerical abundance, diversity and distribution in the various strata. Ants are found in all types of samples and were considered the single most dominant of all families identified. Parasitic wasps were the other dominant group. This group is probably important in controlling the populations of many types of herbivorous insects as previously discussed.

The sagebrush habitat contained the largest captures of ground-dwelling fauna in June of any habitat type sampled. The majority of the specimens taken were in one species group of Collembola, which was captured in both pitfall and litter samples. Litter layers at this site were probably the least conducive to large population buildups of Collembola than at any of the other sites because the litter layer was generally shallow and found only at the bases of sagebrush plants. Physical factors which are conducive to surface activity of Collembola were previously discussed.

In July, Collembola were again numerous in pitfall samples but almost absent from litter samples. A favorable moisture supply again probably allowed for surface activity of this group; however, they probably retreated into the soil during harsher daytime periods of low humidity and high temperatures. It is possible that because of shallow litter layer, little shelter and humidity was afforded this group. Therefore, they may have been forced to seek shelter in more favorable microhabitats such as under rocks, and at the bases of relatively large shrubs and grass clumps.

Pitfall traps captured large numbers of ants in nearly all sampling periods. In June alone, over 500 ants were captured in the grid, which was a relatively large number foraging in an area of 100 m^2. This family can have a substantial effect on the vegetation of an area, particularly if they are existing as herbivores. In this role, which is common in many species during the spring, they gather seeds and crop young plants for food. Although western harvester ants were not included in the captures, their ability as seed gatherers and plant harvesters as reported in the literature is worth mentioning to give some idea of efficiency of members of this family in depleting the vegetation to obtain food. Rogers (1972) found that three medium-sized colonies could remove nearly 20 pounds of seeds per acre over a period of a year. In another study, Clark and Comanor (1975) determined that plant removal from around mounds in Nevada amounted to cutting of over 150 million plants per hectare per year.

Capture totals of invertebrates taken in herbaceous sweep samples were very low in all periods in view of the apparent abundance of grasses and forbs observed in the sagebrush habitat. No groups were numerically abundant in any period, and capture totals were relatively low compared to other sites in two of the three periods.

Samples from sagebrush in the sagebrush habitat contained relatively few herbivores or captures of any kind in nearly all sample periods. The numerically dominant group was the same species group of Curculionidae found on sagebrush at the north slope/pinyon-juniper site. The potential effects of this group on sagebrush plants was discussed previously.

Malaise trap results were nearly identical to those of other habitats in terms of abundant groups, total numbers and seasonal trends of the fauna. Abundant groups during one or more sampling periods included Cecidomyiidae, adult moths, and Anthomyiidae. Chironomidae were abundant in June, although there is no permanent water source in the immediate vicinity of this site. Members of the family are weak flyers and depend on wind for dispersal, which probably is the means by which they arrived at the sagebrush habitat.

Parasitic wasps were the most diverse group of insects captured by all sampling techniques other than those designed for ground-dwelling invertebrates. They are important in that they control the populations of many insect groups, particularly herbivores as previously discussed.

Ground-dwelling invertebrate captures in the mixed brush habitat were relatively low in June compared to other habitats, probably because Collembola were not as numerous here as they were in most of the other habitats. This is puzzling in view of the deep litter available at this site which appeared to be ideal habitat for Collembola populations. The relatively low numbers of Collembola appearing in litter samples were approximately equal in numbers for all sampling periods, an indication that moisture conditions were adequate for Collembola populations to exist throughout the season.

Ants were the numerically dominant group in pitfall samples in all sampling periods, and were relatively abundant in June and July litter samples at the mixed brush site.

The ground-dwelling fauna was diverse at the mixed brush site, with a variety of groups captured in all periods in both litter and pitfall samples.

Sweeps from vegetation other than the dominant shrub species contain the largest number of invertebrates in July and September of any habitat sampled. In both sampling periods, Aphididae was by far the most numerous family captured, totaling over 140 individuals in July and 1,300 in September. Visual observation of the vegetation in September revealed that the few rabbitbrush plants in the habitat were covered with Aphididae. The Aphididae appeared to be of the same species group, therefore it is possible that all came from the rabbitbrush plants sampled in the herbaceous sweep samples. If this is the case, such a large number of Aphididae on so few rabbitbrush plants could have an adverse effect on the rabbitbrush by removal of plant sap.

Samples from serviceberry in June and July did not contain insects in sufficient numbers to indicate possible plant damage by herbivorous insects. In September, total captures increased substantially with most of these being herbivores in the orders Hemiptera and Homoptera. Visual observation of the plants in September indicated that most of the foliage had dried up, and as a result it was difficult to explain the increases in the fauna from the earlier sampling periods.

Samples taken from snowberry were similar in composition to those taken from serviceberry. None of the herbivore groups present were abundant enough to cause widespread plant damage. The September snowberry fauna consisted primarily of Sminthuridae and Thysanoptera. In view of the observation that foliage of snowberry was nearly dry, it is possible that the fauna was actually present in litter under the plants preparing for the change in seasons, since both groups over-winter in the litter in the adult stage.

In Malaise trap samples, two groups, Chironomidae and adult moths, were abundant in all sampling periods. Chironomidae were very abundant in June, which appeared to be the result of large emergences from the nearby creek. This was consistant with Malaise results from other sites where Chironomidae were also the most abundant group captured in June. This family also had large total captures in July and September. This is consistant with the literature which shows that many species of Chironomidae have large peaks early in the season with continued smaller peaks throughout the warm months (Judd, 1962).

Adult moths were most abundant in July and also very common in June and September. As stated in the discussion of results for the south slope/pinyon-juniper habitat, the large number of adult moths in July was probably the result of pupation of larvae present in the early sampling period and subsequent emergence of adults. The presence of relatively large numbers in June indicated that groups captured probably over-wintered as larvae and began the transformation to the adult stage in June after temperatures increased to the point where overall insect activity began.

Lonchaeidae was one of the families found exclusively in the mixed brush habitat. Most of the species in this family occur chiefly in moist or shady places, and the larvae are secondary invaders of diseased or injured plant tissue (Borror and DeLong, 1971). Their abundance in June and July samples was indicative that some portion of the vegetation had been damaged in some manner. Vegetation sampling results from mixed brush stands did not indicate any apparent widespread damage to a particular plant species nor any widespread damage to all of the plants within a mixed brush stand. Possible sources of damage which could have provided the source of larval food may have been browsing by horses in the winter or crushing of the foliage by cattle which are abundant in the area during the summer.

The presence of numerous cattle at the site may also have been the reason for the relative abundance of Sepsidae in the Malaise trap samples. The larvae live in excrement and the adults are often numerous near the excrement (Borror and DeLong, 1971).

Anthomyiidae was the most abundant family in July and September samples as at other sites. Their feeding habits were unknown, but their abundance makes them an important group in some aspect of the food web at this site as well as at all other sites.

Total captures of invertebrates over the summer were greatest in the greasewood-sagebrush and sagebrush habitats. Major contributions to these totals came from Malaise trap samples in the greasewood-sagebursh habitat due primarily to large captures of Chironomidae and Anthomyiidae.

The ground-dwelling fauna captured in pitfalls was the most significant factor contributing to the overall invertebrate abundance in the sagebrush habitat. Large numbers of Collembola and Formicidae were responsible for most of this total. The mixed brush site also contained relatively large numbers of invertebrates, primarily due to high capture totals for herbaceous sweep samples. In both of the pinyon-juniper habitats, captures of ground-dwelling invertebrates and active flying insects were relatively high; however, samples from dominant shrubs and trees and herbaceous sweep samples were low in total captures. Low total captures in herbaceous sweep samples from the understory vegetation reflect the small amount of vegetation present.

Of the shrub species sampled, shadscale from the south slope/pinyon-juniper site had the least number and variety of associated herbivorous insects. Rabbitbrush and sagebrush from the greasewood-sagebrush site supported the largest number of invertebrates. By contrast, sagebrush samples from north slope/pinyon-juniper and sagebrush habitats did not support the variety of invertebrates found on sagebrush in the greasewood-sagebrush habitat.

Seasonal trends in captures of the fauna in the various strata of each habitat indicate that peak populations occurred in July at all sites. Numbers of invertebrates in Malaise trap samples did not peak in July, however, but demonstrated the highest total captures in June and the lowest in September. Much of the reduction in captures from June to July at each site was due to the reduction in the number of Chironomidae which emerged in large numbers from nearby water sources in June.

The major orders of ground-dwelling invertebrates collected over all sample sites and all sample periods were Collembola and Acari. Collembola were very abundant at three sites, north and south slope/pinyon-juniper and the sagebrush habitat. Capture trends for the orders had a large peak in either June or July with substantial reductions or complete absence in September. Capture totals were related to the presence of adequate moisture needed to prevent dessication and facilitate feeding.

Acari were abundant at all sites, with large increases in captures as the season progressed. Moisture and heat effects which caused reductions in Collembola populations did not affect the most numerous group of mites, the hard-bodied Orbatids, because of their relative resistance to heat and moisture stress.

Most of the active flying insects were contributed by a variety of dipteran and hymenopteran families. A number of families were collected in large numbers at all sites including the two families which had the largest total captures, Anthomyiidae and Chironomidae. Anthomyiidae increased from relatively few captures at most sites in June to by far the largest total captures in July and September. Greasewood-sagebrush, sagebrush, and mixed brush habitats contributed most of the total Anthomyiidae captures. Cecidomyiidae were abundant in June at all sites, but varied in relative abundance by site in July and September.

Adult moths were abundant at all sites in July, and nearly all sites in September sampling periods. The major increase in total captures from June to July was the result of pupation of Lepidoptera larvae found most frequently in the June samples.

Phalangida and Psocoptera were abundant only at the greasewood-sagebrush site. The presence of large numbers of Phalangida in June only is related to the frequency of available free water. Two families were abundant only in samples from the greasewood-sagebrush habitat. Both are probably associated with rye grass, the dominant herbaceous species in the greasewood-sagebrush habitat. Chloropidae larvae are plant tissue feeders which inhabit the stems of the grasses and can cause reductions in seed production. The adults were abundant

in July samples only. September samples contained large numbers of a seed bug (Lygaeidae) which was abundant only in this period after rye grass seed formation was completed. This family is also known as a plant pest in certain situations.

South slope/pinyon-juniper was the only habitat which contained scorpions (Scorpionida) in the ground-dwelling fauna. Their presence at only this site is related to the overall higher ground temperatures that occur on this south-facing slope. Shadscale from the south slope/pinyon-juniper habitat was the only shrub species sampled upon which Chironomidae were suspected to be feeding, although this group was present and abundant at all sites. The Chironomidae were suspected to be feeding on liquids secreted by the plants. The south slope/pinyon-juniper habitat was also the only site in which ants were observed tending aphids.

At the north slope/pinyon-juniper site, no families of insects were captured that were not found at other sites; however, Apidae and Andrenidae were abundant at this site and not at the other sites. These two groups are important as pollinators, and it is suspected that their abundance in the north slope/pinyon-juniper habitat probably is related to the availability of nesting sites in dead trees.

No abundant families were found exclusively in the sagebrush habitat. The most significant aspect of samples taken at this site was the presence of unusually large numbers of Collembola in June and July, although the litter present did not seem to be sufficient in terms of depth or abundance relative to the other four sites.

The mixed brush habitat produced two families of flies which were only abundant in this vegetation type. Lonchaeidae larvae feed on damaged plant material, and abundance of the adult stage may indicate that damage had occurred to some portion of the vegetation. Despite this apparent cause-effect relationship, no readily visible damage was observed in the vegetation. Probable causes of vegetation damage may have been browsing by horses or physical damage by cattle continuously moving back and forth through the site. The remaining

abundant fly family, Sepsidae, was associated with large amounts of cattle dung at the site which probably provided the food source and substrate for larval development.

At all sites, the dominant shrub and tree species sampled had an associated complement of herbivorous insects which were contributed primarily by the orders Hemiptera and Homoptera. In most cases these species groups were different for each plant species because of the host species specificity of the families involved.

When all sites and strata within each site are considered, the dominant family overall was Formicidae. They were present and abundant in every type of sample. In most samples of ground dwelling invertebrates, Formicidae were either the most abundant group, or second in abundance to Collembola. They were found foraging on all of the shrub and tree species sampled and also were observed tending aphids on one species of herbaceous plant. Finally, Malaise trap results give an additional indication of their importance in that almost five hundred reproductives were captured over the summer.

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Figures and Tables for the Invertebrate Section

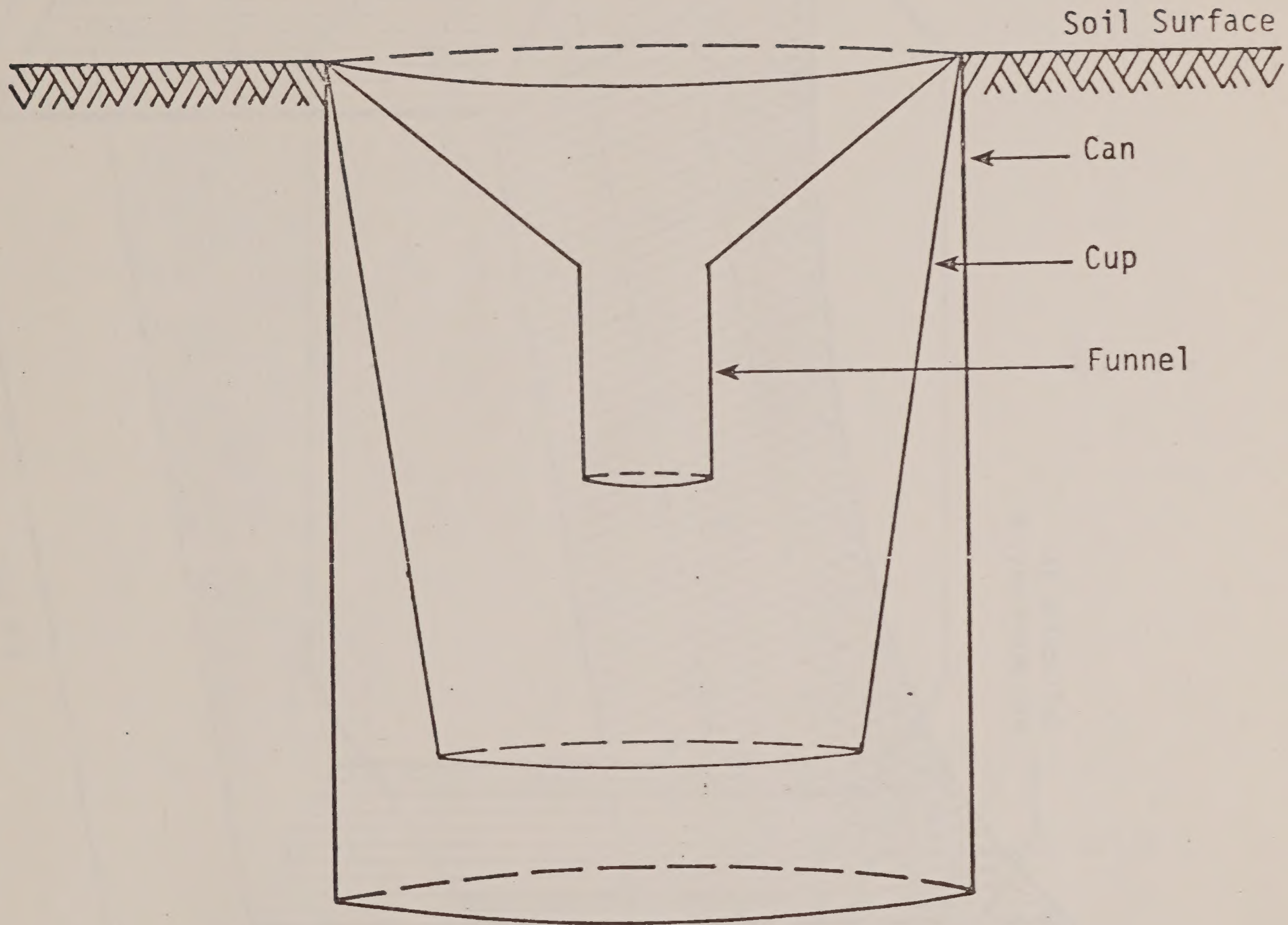

Figure 3-7-72. Invertebrate pitfall trap used for RBOSP.

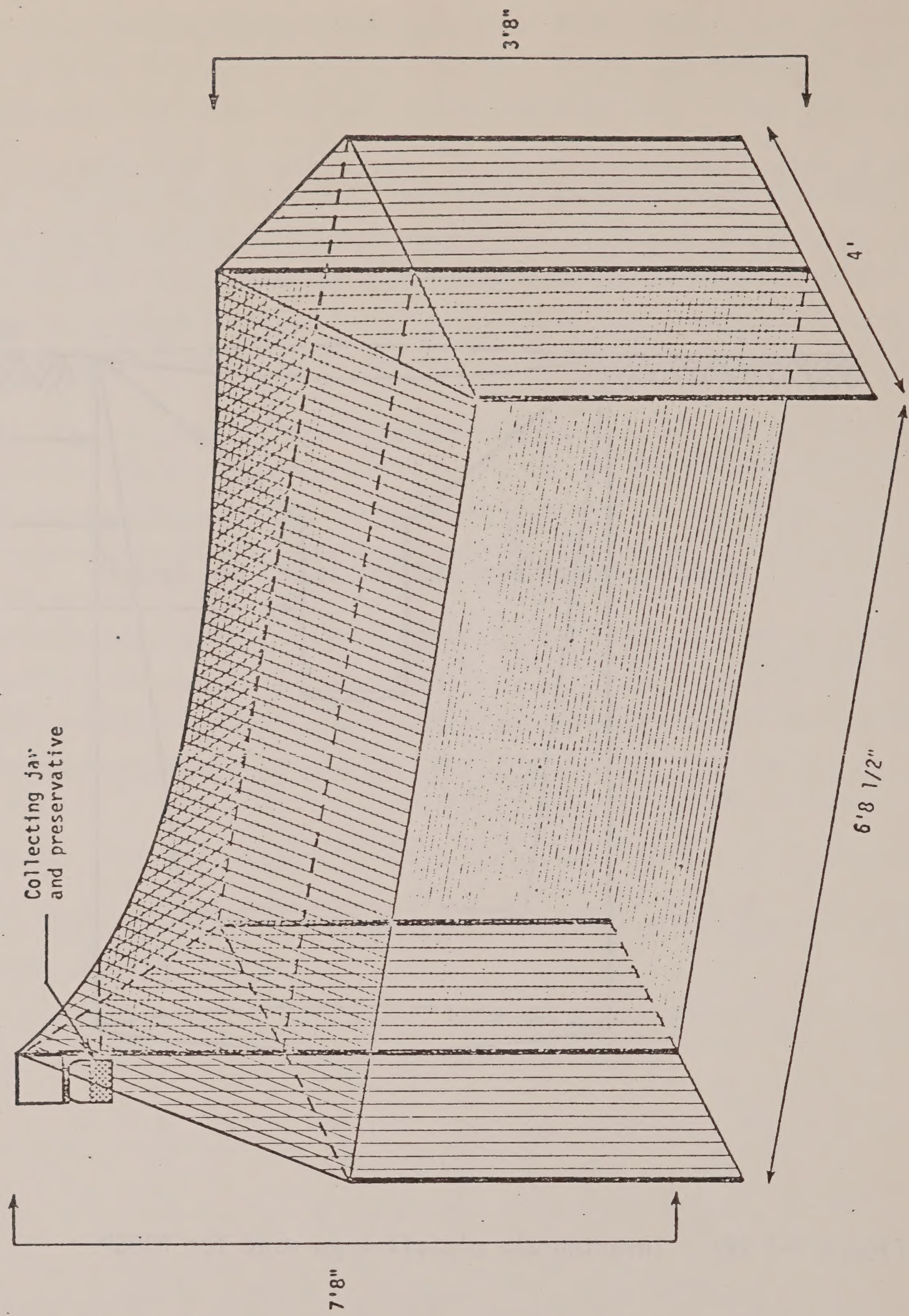

Figure 3-7-73. Malaise trap used for RBOSP.

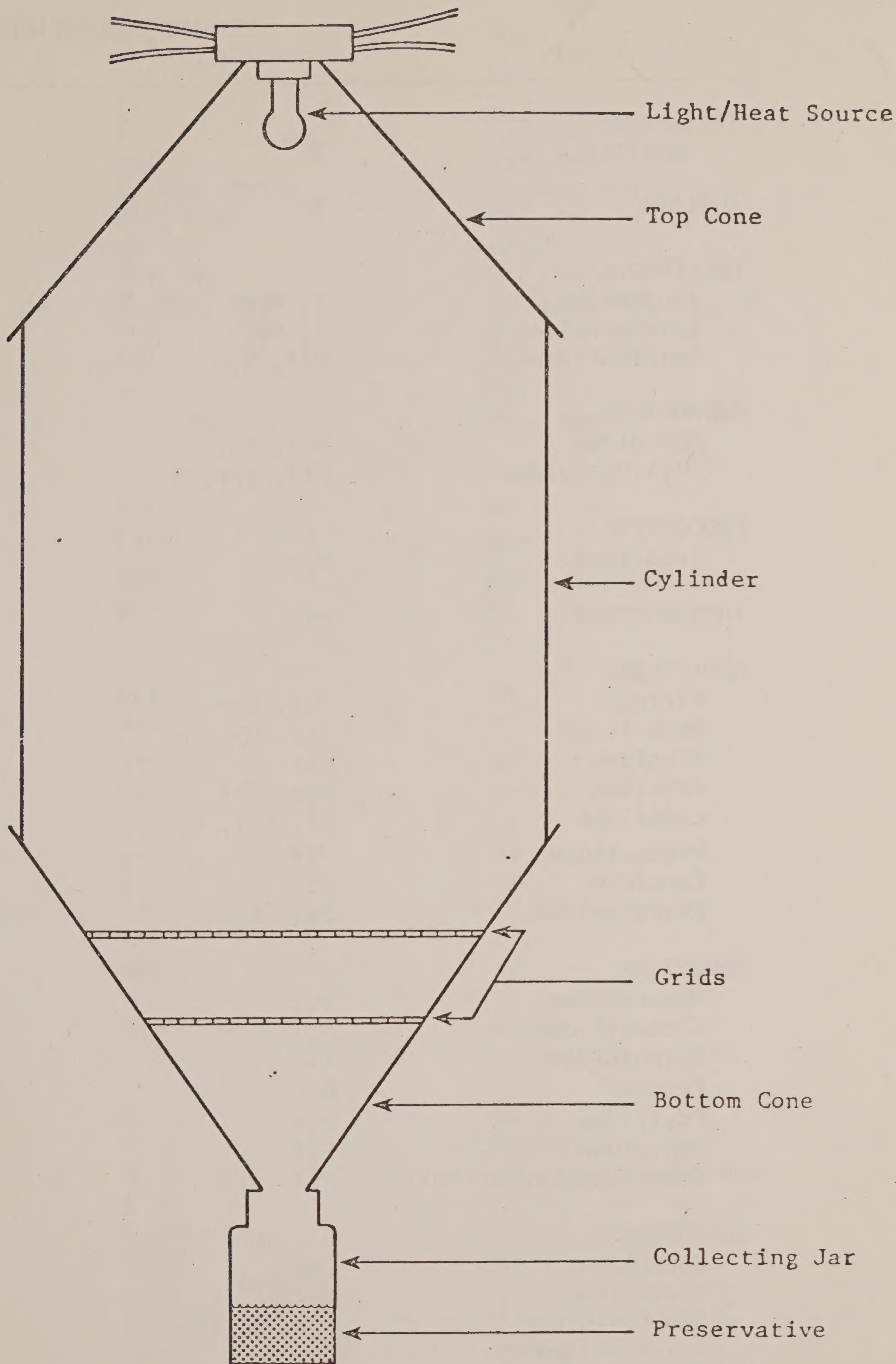

Figure 3-7-74 Berlese funnel used for RBOSP.

Table 3-7-258. Feeding types for immatures and adults of all invertebrates collected at each sample site during June, 1975 for RBOSP

ORDER Family *	FOOD HABIT CLASSIFICATION Immature	Adult
THYSANURA		
Machilidae	S***	S
DIPLURA	S	S
COLLEMBOLA		
Isotomidae	S, Myp	S, Myp
Entomobryidae	S, Myp	S, Myp
Sminthuridae	Ptf, Myp	Ptf, Myp
ORTHOPTERA		
Acrididae	Ptf, Epr	Ptf, Epr
Gryllacrididae	Ptf, Epr, S	Ptf, Epr, S
PSOCOPTERA		
Trogiidae	Myp	Myp
THYSANOPTERA	Ptf	Ptf
HEMIPTERA		
Miridae	Psf, Epr	Psf, Epr
Reduviidae	Epr, Mp	Epr, Mp
Tingidae	Psf	Psf
Aradidae	Myp, Psf	Myp, Psf
Lygaeidae	Sf, Psf, Epr	Sf, Psf, Epr
Piesmatidae	Ptf	Ptf
Coreidae	Ptf	Ptf
Pentatomidae	Psf, Epr	Psf, Epr
HOMOPTERA		
Membracidae	Psf	Psf
Cicadellidae	Psf	Psf
Delphacidae	Psf	Psf
Issidae	Psf	Psf
Psyllidae	Psf	Psf
Aphididae	Psf	Psf
Coccoidea (superfamily)	Psf	Psf
COLEOPTERA		
Carabidae	Epr	Epr,Ptf
Histeridae	Epr	Epr
Staphylinidae	Epr, S, Epa	Epr, S
Scydmaenidae	S	S
Cantharidae	Epr	Pf, Nf
Lampyridae	Epr	Epr
Dermestidae	S, Ptf	S, Ptf
Ostomidae	Ptf	Ptf
Cleridae	Epr	Epr
Elateridae	Ptf, Sf	Ptf
Erotylidae	Myp	Myp

ORDER Family */	FOOD HABIT CLASSIFICATION Immature	Adult
COLEOPTERA (Cont.)		
Lathridiidae	Myp	Myp
Coccinellidae	Epr, Ptf	Epr, Ptf
Anthicidae	**/	**/
Meloidae	Epr	Ptf
Buprestidae	Ptf	Ptf, Nf
Tenebrionidae	S, Myp, Ptf	S, Myp, Ptf
Melandryidae	Ptf, Myp	Ptf, Myp
Ptinidae	**/	**/
Anobiidae	Ptf, Myp	Ptf, Myp
Scarabaeidae	S, Myp, Ptf	S, Myp, Ptf, Pf, Nf
Byrrhidae	Ptf	Ptf
Chrysomelidae	Ptf	Ptf
Curculionidae	Ptf	Ptf
Scolytidae	Ptf, Myp	Ptf, Myp
NEUROPTERA		
Hemerobiidae	Epr	Epr
Chrysopidae	Epr	Epr
Raphidiidae	Epr	Epr
Myrmeleontidae	Epr	Nf
LEPIDOPTERA		
Pieridae	Ptf	Nf
Satyridae	Ptf	Nf
Hesperidae	Ptf	Nf
Lycaenidae	Ptf	Nf
Arctiidae	Ptf	Nf
Noctuidae	Ptf	Nf
Geometridae	Ptf	Nf
Pyralidoidea (super-family)	Ptf	Nf
Pterophoridae	Ptf	Nf
Tortricoidea (super-family)	Ptf	Nf
DIPTERA		
Tipulidae	S, Ptf	Nf
Psychodidae	S	Mp, Nf
Chironomidae	S	Nf, Aphid excretion
Simulidae	S	Mp
Bibionidae	S, Ptf	**/
Mycetophilidae	Myp	Nf
Sciaridae	Myp, S, Ptf	Nf
Cecidomyiidae	Ptf, S, Epr	**/
Therevidae	Epr	Psf**/
Asilidae	Epr	Epr
Acroceridae	*/	S
Bombylidae	*/	Nf
Empididae	Epr	Epr
Dolichopodidae	Epr	Epr
Phoridae	S, Myp, Epa	S**/
Pipunculidae	Epa, Epr	**/
Syrphidae	Epr, S, Ptf	Nf
Psilidae	*/	*/
Otitidae	Ptf, Epa	**/

ORDER Family */	FOOD HABIT CLASSIFICATION Immature	Adult
DIPTERA (Cont.)		
Tephritidae	Ptf	**/
Sepsidae	S	S**/
Sçiomyzidae	Epr	**/
Chamaemyiidae	Epr	**/
Lonchaeidae	Ptf	**/
Chloropidae	Epr, Epa, Ptf, S, Mp	Nf**/
Heleomyzidae	S, Myp	**/
Trixoscelidididae	**/	**/
Agromyzidae	Ptf	Nf
Anthomyiidae	Ptf, S, Epr	Nf**/
Muscidae	S	S, Mp
Calliphoridae	S, Mp	S, Mp
Tachinidae	Epa	Nf**/
HYMENOPTERA		
Xyelidae	Ptf	Nf
Argidae	Ptf	
Diprionidae	Ptf	
Tenthridinidae	Ptf	Nf
Braconidae	Epa	Nf
Ichneumonidae	Epa	Nf
Mymaridae	Epa	Nf
Trichogrammatidae	Epa	Nf
Eulophidae	Epa	Nf
Encyrtidae	Epa	Nf
Eupelmidae	Epa	Nf
Pteromalidae	Epa	Epr, Nf
Chalcididae	Ptf	Nf
Figitidae	Epa	**/
Cynipidae	Ptf, Epa	Nf
Proctotrupidae	Epa	**/
Ceraphronidae	Epa	Nf
Diapriidae	Epa	Nf
Scelionidae	Epa	Nf
Platygasteridae	Epa	Nf
Dryinidae	Epa	**/
Tiphiidae	Epa	Nf, Epr
Bethylidae	Epr	Nf
Formicidae	Epr, Ptf, S, Psf, Nf	Epr, Ptf, S, Psf, Nf
Pompilidae	Epr	Nf, Epr
Vespidae	Epr, S	Nf, Pf
Sphecidae	Epr	Nf
Colletidae		
Andrenidae	Pf, Nf	Pf, Nf
Halictidae	Pf, Nf	Nf, Pf
Megachilidae	Pf, Nf, Epa	Nf
Apidae	Pf, Nf	Nf, Pf
SCORPIONIDA	Epr	Epr
CHELONETHIDA	Epr	Epr

Table 3-7-258. (Continued)

ORDER Family*/	FOOD HABIT CLASSIFICATION Immature	Adult
SOLPUGIDA	Epr	Epr
ARANEIDA		
Dictynidae	Epr	Epr
Amaurobiidae	Epr	Epr
Pholeidae	Epr	Epr
Therediidae	Epr	Epr
Araneidae	Epr	Epr
Tetragnathidae	Epr	Epr
Agelenidae	Epr	Epr
Hahniidae	Epr	Epr
Pisauridae		
Lycosidae	Epr	Epr
Oxyopidae	Epr	Epr
Gnaphosidae	Epr	Epr
Thomisidae	Epr	Epr
Salticidae	Epr	Epr
PHALANGIDA	S	S
ACARI	S, Mp, Epa, Epr, Psf, Ptf	S, Mp, Epa, Epr, Psf, Ptf
LITHOBIOMORPHA	Epr	Epr
GEOPHILOMORPHA	Epr	Epr
PAUROPODA	S	S
SYMPHYLA	S	S

*/ Common names, correct spelling, and taxonomic order from: Borror, D.J. and DeLong, D.M. 1971. An Introduction to the study of insects. Holt, Rinehart, and Winston. New York. 812 pp.

**/ Denotes families where food habits are unknown or little known.

***/ See page 3-7-669 for classification definitions.

Table 3-7-259. Site descriptions for invertebrate sampling locations for RBOSP.

LOCATION DESIGNATION Invertebrate Sample Sites	Vegetation Type	Aspect/Elevation
1 (A)*	Greasewood/sagebrush	Flat/6400'
2 (B)*	Pinyon-juniper	South/7000'
3 (C)*	Pinyon-juniper	North/6900'
4 (D)*	Sagebrush	North/7100'
5 (5)*	Mixed brush	North/7200'

*Corresponding small mammal sampling location shown in Figure 3-7-27.

Table 3-7-260. Invertebrate groups identified to date for RBOSP

ORDER Family	Common Name
THYSANURA	
Machilidae	Jumping bristletails
DIPLURA	
COLLEMBOLA	
Isotomidae	Elongate-bodied springtails
Entomobryidae	Elongate-bodied springtails
Sminthuridae	Globular springtails
ORTHOPTERA	
Acrididae	Short-horned grasshoppers
Gryllacrididae	Long-horned grasshoppers
Mantidae	Mantids
PSOCOPTERA	
Trogiidae	Psocids
Psocidae	Psocids
THYSANOPTERA	
Phlaeothripidae	Thrips
HEMIPTERA	
Anthocoridae	Minute pirate bugs
Miridae	Plant bugs
Nabidae	Damsel bugs
Reduviidae	Assassin bugs
Tingidae	Lace bugs
Aradidae	Flat bugs
Lygaeidae	Seed bugs
Piesmatidae	Ash-grey leafbugs
Coreidae	Leaf-foot bugs
Pentatomidae	Sting bugs
Cydnidae	Burrower bugs
HOMOPTERA	
Membracidae	Treehoppers
Cicadellidae	Leafhoppers
Cercopidae	Froghoppers
Delphacidae	Delphacid planthoppers
Issidae	Issid planthoppers
Psyllidae	Psyllids
Aphididae	Aphids
COLEOPTERA	
Carabidae	Ground beetles
Histeridae	Hister beetles

Table 3-7-260. (Continued)

ORDER Family	Common Name
COLEOPTERA (Continued)	
Staphylinidae	Rove beetles
Scydmaenidae	Antlike stone beetles
Cantharidae	Soldier beetles
Lampyridae	Lightening bugs
Dermestidae	Dermestid beetles
Ostomidae	Bark-gnawing beetles
Cleridae	Checkered beetles
Elateridae	Click beetles
Buprestidae	Metallic wood-boring beetles
Byrrhidae	Pill beetles
Erotylidae	Pleasing fungus beetles
Lathridiidae	Minute brown scavenger beetles
Coccinellidae	Ladybird beetles
Anthicidae	Antlike flower beetles
Meloidae	Blister beetles
Alleculidae	Comb-clawed beetles
Tenebrionidae	Darkling beetles
Melandryidae	False darkling beetles
Ptinidae	Spider beetles
Anobiidae	Death-watch beetles
Scarabaeidae	Scarab beetles
Chrysomelidae	Leaf beetles
Curculionidae	Snout beetles
Scolytidae	Bark beetles
NEUROPTERA	
Hemerobiidae	Brown lacewings
Chrisopidae	Green lacewings
Myrmeleontidae	Antlions
Raphidiidae	Raphidiid snakeflies
LEPIDOPTERA	
Pieridae	Sulphurs, whites, and orange tips
Satyridae	Satyrs and wood nymphs
Nymphalidae	Brush-footed butterflies
Lycaenidae	Gossamer-winged butterflies
Hesperidae	Skippers
Arctiidae	Tiger moths
Noctuidae	Armyworm and cutworm moths
Geometridae	Geometer moths
Pyralidae	Pyralid moths
Sphingidae	Sphinx mothes
Lasiocampidae	Tent caterpillars
Coleophoridae	Casebearers and lappet moths
Gracilariidae	Leaf blotch miners

Table 3-7-260. (Continued)

ORDER Family	Common Name
DIPTERA	
Tipulidae	Crane flies
Psychodidae	Moth flies--sand flies
Culicidae	Mosquitos
Chironomidae	Midges
Simuliidae	Black flies
Bibionidae	March flies
Mycetophilidae	Fungus gnats
Sciaridae	Dark-winged fungus gnats
Cecidomyiidae	Gall midges
Therevidae	Stiletto flies
Asilidae	Robber flies
Acroceridae	Small-headed flies
Bombyciidae	Bee flies
Empididae	Dance flies
Dolichopodidae	Long-legged flies
Phoridae	Humpedbacked flies
Pipunculidae	Big-headed flies
Syrphidae	Syrphid flies
Psilidae	Rust flies
Otitidae	Picture-winged flies
Tephritidae	Fruit flies
Sepsidae	Black scavenger flies
Sciomyzidae	Marsh flies
Chaemaemyiidae	Aphid flies
Lonchaeidae	Lonchaeid flies
Sphaeroceridae	Small dung flies
Chloropidae	Chloropid flies
Agromyzidae	Leaf-miner flies
Heleomyzidae	Heleomyzid flies
Trixoscelididae	Trixoscelidid flies
Anthomyiidae	Anthomyiid flies
Muscidae	House flies
Calliphoridae	Blow flies
Tachinidae	Tachinid flies
SIPHONAPTERA	
Publicidae	Fleas
HYMENOPTERA	
Xyelidae	Xyelid sawflies
Argidae	Argid sawflies
Diprionidae	Conifer sawflies
Tenthredinidae	Common sawflies
Braconidae	Braconid wasps
Ichneumonidae	Ichneumonid wasps

Table 3-7-260. (Continued)

ORDER Family	Common Name
HYMENOPTERA (Continued)	
Mymaridae	Fairyflies
Trichogrammatidae	Trichogrammatid wasps
Eulophidae	Eulophid wasps
Encyrtidae	Encyrtid wasps
Eupelmidae	Eupelmid wasps
Pteromalidae	Pteromalid wasps
Chalcididae	Chacid wasps
Figitidae	Figitid wasps
Cynipidae	Gall wasps
Proctotrupidae	Prototrupid wasps
Ceraphronidae	Ceraphronid wasps
Diapriidae	Diapriid wasps
Scelionidae	Scelionid wasps
Platygasteridae	Platygasterid wasps
Chrysididae	Cuckoo wasps
Bethylidae	Bethylid wasps
Dryinidae	Dryinid wasps
Tiphiidae	Tiphiid wasps
Mutillidae	Velvet ants
Formicidae	Ants
Vespidae	Paper wasps
Pompilidae	Spider wasps
Sphecidae	Sphecid wasps
Colletidae	Yellow-faced bees
Andreidae	Andrenid bees
Halicitidae	Halicitid bees
Megachilidae	Leafcutting bees
Apidae	Honey bees
SCORPIONIDA	Scorpions
CHELONETHIDA	Pseudoscorpions
SOLPUGIDA	Sun scorpions
ARANEIDA	Spiders
Dictynidae	Dictynid spiders
Amaurobiidae	Amaurobiid spiders
Pholcidae	Pholcids and cellar spiders
Theridiidae	Comb-footed spiders
Araneidae	Orb weavers
Agelenidae	Funnel-web spiders
Hahniidae	Hahniid spiders
Pisuridae	Nursery-web spiders
Lycosidae	Wolf spiders
Oxyopidae	Lynx spiders

Table 3-7-260. (Continued)

ORDER Family	Common Name
ARANEIDA (Continued)	
Gnaphosidae	Hunting spiders
Clubionidae	Sac spiders
Thomisidae	Crab spiders
Salticidae	Jumping spiders
PHALANGIDA	Harvestmen
ACARI	Ticks and mites
LITHOBIOMORPHA	Centipedes
GEOPHILOMORPHA	Centipedes

1/ Common names, correct spelling, and taxonomic order from:

Borror, D.J. and M.D. DeLong. 1971. An introduction to the study of insects. Holt, Rinehart and Winston. New York. 812 pages.

Table 3-7-261 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 1, greasewood-sagebrush, during June, 1975 for RBOSP

taxon	# collected	percent relative abundance**	density (#/M2)
THYSANURA	17	7.30	1.35
COLLEMBOLA	14	6.01	0.12
COLEOPTERA	39	16.74	***
LEPIDOPTERA	15	6.44	0.22
HYMENOPTERA	46	19.74	***
ARANEIDA	28	12.02	0.80
PHALANGIDA	51	21.89	1.42
ACARI	23	9.87	0.22

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 1/# collected all taxa, site 1) X 100
*** assumptions of density estimation method not met

Table 3-7-262. Percentages of ground dwelling invertebrates within each feeding type collected by pitfall traps at each sampling site during June, 1975 for RBOSP

	Site 1	Site 2	Site 3	Site 4	Site 5
Herbivores	6	0	0	0	4
Flower feeders	0	0	0	0	0
Fungus feeders	0	0	0	0	0
Saprovore	36	90	62	92	23
Omnivores	20	2	10	5	30
Predators	27	2	20	1	21
Unknown	11	6	8	2	22

Table 3-7-263 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 1, greasewood-sagebrush, during July 1975 for RBOSP

Taxon	# collected	Percent Relative abundance**	Density (#/M2)
THYSANURA	77	5.46	***
COLLEMBOLA	130	9.23	***
ORTHOPTERA	10	0.71	0.21
PSOCOPTERA	180	12.78	***
HOMOPTERA	91	6.46	***
COLEOPTERA	42	2.98	***
LEPIDOPTERA	3	0.21	***
DIPTERA	19	1.35	***
HYMENOPTERA	184	13.06	***
ARANEIDA	130	9.23	6.55
PHALANGIDA	90	6.39	1.22
ACARI	452	32.08	***
LITHOBIOMORPHA	1	0.07	***

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 1/# collected all taxa, site 1) X 100
*** assumptions of density estimation method not met

Table 3-7-264. Numbers and percentages of invertebrates within each feeding type taken in pitfall trap samples at each site during July 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5 #	Site 5 %
Herbivores	197	14.0	16	1.8	17	1.4	31	0.9	26	3.7
Flower feeders	0	0.0	0	0.0	0	0.0	0	0.0	00	0.0
Fungus feeders	7	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Saprovore	394	28.0	44	4.8	408	33.9	2671	77.9	287	40.7
Omnivores	184	13.2	85	9.3	91	7.6	504	14.7	230	32.6
Predators	156	11.2	28	3.1	83	6.9	56	1.6	57	8.1
Unknown	471	33.5	741	81.1	603	50.2	168	4.9	105	14.9

Table 3-7-265 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 1, greasewood-sagebrush during September 1975 for RBOSP

Taxon	# collected	Percent Relative abundance**	Density (#/M2)
THYSANURA	37	4.99	***
COLLEMBOLA	63	8.50	0.86
ORTHOPTERA	9	1.21	***
PSOCOPTERA	32	4.32	***
COLEOPTERA	41	5.53	1.04
LEPIDOPTERA	3	0.40	0.04
HYMENOPTERA	141	19.03	1.80
ARANEIDA	52	7.02	0.66
PHALANGIDA	37	4.99	0.36
ACARI	325	43.86	5.20
LITHOBIOMORPHA	1	0.13	0.01

* catch-effort regression method (Gist and Crossley, Jr.,1973)
** (# collected each taxon, site 1/# collected all taxa, site 1) X 100
*** assumptions of density estimation method not met

Table 3-7-266. Numbers and percentages of invertebrates within each feeding type taken in pitfall trap samples at each site during September 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5 #	Site 5 %
Herbivores	49	6.6	4	1.8	3	0.7	42	10.0	11	4.9
Flower feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fungus feeders	6	0.8	0	0.0	1	0.2	0	0.0	0	0.0
Saprovores	139	18.7	14	6.4	21	4.9	6	1.4	44	19.6
Omnivores	141	19.0	90	40.9	17	4.0	119	28.2	34	15.1
Predators	79	10.6	78	35.5	42	9.9	52	12.3	63	28.0
Unknown	329	44.3	34	15.4	341	80.3	203	48.1	73	32.4

Table 3-7-267. Results of litter d-vac invertebrate sampling at site 1, greasewood-sagebrush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted* #	litter dry weight (gm)	# of invertebrates per kilogram litter
132	0	0.00	174.00	0.0
133	20	20.00	170.00	117.6
134	4	4.00	220.00	18.2
135	14	14.00	585.00	23.9
136	18	18.00	595.00	30.3

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-268. Average number of invertebrates collected from litter by the d-vac method at each sampling site during June, 1975 for RBOSP

site	vegetation type	# of samples	avg. # of inverts. per kilogram litter	variance	std. error
1	greasewood-sagebrush	5	38.0	2109.6	20.5
2	pinyon-juniper (south slope)	5	1.8	3.3	0.8
3	pinyon-juniper (north slope)	5	5.0	37.5	2.7
4	sagebrush	5	519.4	339477.0	260.6
5	mixed brush	5	126.9	10202.3	45.2

Table 3-7-269. Results of Litter D-vac sampling at each site during June, 1975 for RBOSP

ORDER Family	Common Name	Site 1 A1/	Site 1 B2/	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
THYSANURA											
Machilidae	jumping bristletails									1	1
COLLEMBOLA											
Isotomidae	elongate-bodied springtails							1	49		
Entomobryidae	elongate-bodied springtails							1	1	1	37
THYSANOPTERA	thrips	1	1							1	1
HEMIPTERA	true bugs	-	1					-	4	-	5
HOMOPTERA	hoppers	-	2			-	1	-	3	-	10
COLEOPTERA											
Carabidae	ground beetles	3	9					1	3	1	2
Carabidae-larvae	ground beetles	1	7			1	3				
Staphylinidae	rove beetles	2	2			1	1	1	1	1	1
Cleridae	checkered beetles							1	1	1	1
Anthicidae	antlike flower beetles	1	4								
Tenebrionidae	darkling beetles							1	1		
Melandryidae	false darkling beetles	1	1								
Chrysomelidae	leaf beetles	1	1								
Curculionidae	snout beetles	1	2			2	2			2	2
Unknown larvae		1	1			1	1			-	11
LEPIDOPTERA											
Hesperidae larvae	skippers							1	1		
Noctuidae larvae	armyworms & cutworms	-	2					-	2	1	1
Pyralidoidea larvae	plume moths, snout moths							1	1	1	1
Unknown larvae								1	1		

Table 3-7-269. (Continued)

ORDER Family	Common Name	Site 1 A1/	Site 1 B2/	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
DIPTERA											
Unknown larvae	flies					1	1			1	12
HYMENOPTERA											
Dryinidae (non-winged)	dryinid wasps							1	1		
Formicidae	ants	1	1	3	3	2	3	7	210	7	63
Formicidae (pupae)								1	64		
Unknown (winged)		-	8					1	1	1	1
CHELONETHIDA	pseudoscorpions									1	14
ARANEIDA											
Dictynidae	dictynid spiders	-	10					-	2	-	8
Gnaphosidae	hunting spiders	-	3								
Thomisidae	crab spiders							-	3		
Salticidae	jumping spiders							-	2		
Unknown						1	1	1	1		
PHALANGIDA	harvestmen	1	1								
ACARI	ticks & mites							-	19	-	26
GEOPHILOMORPHA	centipedes							-	1	1	2
			56		3		13		372		199

1/ A = Number of species groups

2/ B = Total number of individuals

Table 3-7-270. Percentages of invertebrates within each feeding type taken in Litter D-vac samples at each site during June, 1975 for RBOSP

	Site 1	Site 2	Site 3	Site 4	Site 5
Herbivores	16	0	23	2	8
Flower feeders	0	0	0	0	0
Fungus feeders	0	0	0	0	0
Saprovores	2	0	0	14	19
Omnivores	2	100	23	74	32
Predators	55	0	38	4	14
Unknown	25	0	16	7	27

Table 3-7-271 Average number of invertebrates collected from litter by the d-vac method at each sampling site during July 1975 for RBOSP

Site	Vegetation type	# of Samples	Avg. # of inverts. per kilogram litter	Variance	Std. error
1	greasewood-sagebrush	5	53.7	930.2	13.6
2	pinyon-juniper (south slope)	5	33.6	588.3	10.8
3	pinyon-juniper (north slope)	5	61.3	698.0	11.8
4	sagebrush	5	10.9	81.2	4.0
5	mixed brush	5	103.5	5579.1	33.4

Table 3-7-272 Results of litter d-vac invertebrate sampling at site 1, greasewood-sagebrush, during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted # *	Litter dry Weight (gm)	# of invertebrates per kilogram litter
218	16	16.00	342.00	46.8
219	23	23.00	272.00	84.6
220	2	2.00	236.00	8.5
221	23	23.00	290.00	79.3
222	21	21.00	426.00	49.3

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-273 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by litter D-vac sampling at all sites during July 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5 A	 B
COLLEMBOLA											
Isotomidae	elongate-bodied springtails	0	0	0	0	1	53	0	0	0	0
Entomobryidae	elongate-bodied springtails	0	0	1	41	1	14	0	0	1	38
PSOCOPTERA											
Unknown		1	5	0	0	1	4	0	0	1	10
Psocidae	psocids	0	0	1	7	0	0	0	0	0	0
THYSANOPTERA											
Unknown		0	0	3	6	0	0	1	1	0	0
HEMIPTERA											
Unknown		1	6	0	0	0	0	0	0	1	14
HOMOPTERA											
Unknown		1	1	0	0	1	1	0	0	0	0
Cicadellidae	leafhoppers	0	0	0	0	0	0	0	0	1	3
COLEOPTERA											
Unknown		1	4	1	5	1	2	1	3	1	24
Carabidae	ground beetles	1	6	0	0	1	5	0	0	0	0
Staphylinidae	rove beetles	0	0	1	10	1	2	0	0	1	2
Ostomidae	bark-gnawing beetles	0	0	0	0	1	1	0	0	0	0
Lathridiidae	minute brown scavenger beetles	1	2	0	0	0	0	0	0	0	0
Coccinellidae	ladybird beetles	1	1	0	0	0	0	0	0	1	1
Anthicidae	antlike flower beetles	1	1	0	0	0	0	0	0	0	0
Tenebrionidae	darkling beetles	1	1	0	0	1	1	1	3	1	1
Curculionidae	snout beetles	1	1	0	0	2	4	0	0	1	1
LEPIDOPTERA											
Unknown		1	2	1	1	1	1	1	1	1	2
DIPTERA											
Unknown		1	14	1	1	1	2	0	0	1	3
Chironomidae	midges	0	0	0	0	0	0	1	4	0	0
Therevidae	stiletto flies	0	0	1	1	1	4	0	0	1	2
HYMENOPTERA											
Formicidae	ants	2	10	1	2	3	103	0	0	4	18
CHELONETHIDA	pseudoscorpions										
Unknown		0	0	1	12	1	2	0	0	1	17
ARANEIDA	spiders										
Unknown		1	2	0	0	1	6	0	0	1	2
Dictynidae	dictynid spiders	1	1	0	0	1	0	0	0	0	0

Table 3-7-273 (continued)

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
Lycosidae	wolf spiders	0	0	0	0	0	0	0	0	1	1
Gnaphosidae	hunting spiders	0	0	0	0	1	2	0	0	1	8
Thomisidae	crab spiders	0	0	0	0	1	1	0	0	1	1
Salticidae	jumping spiders	0	0	0	0	0	0	0	0	1	1
ACARI	ticks and mites										
Unknown		1	28	1	45	1	29	1	3	1	215
GEOPHILOMORPHA											
Unknown		0	0	0	0	1	1	0	0	1	1
TOTALS		17	85	13	131	23	238	6	15	24	365

Table 3-7-274. Numbers and percentages of invertebrates within each feeding type taken in litter D-vac samples at each site during July 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5 #	Site 5 %
Herbivores	2	2.4	6	4.6	5	2.1	1	6.7	6	1.6
Flower feeders	2	2.4	1	0.8	1	0.4	5	33.3	0	0.0
Fungus feeders	2	2.4	0	0.0	0	0.0	0	0.0	0	0.0
Saprovore	6	7.1	49	37.4	72	30.3	3	20.0	49	13.4
Omnivores	10	11.8	2	1.5	103	43.3	0	0.0	18	4.9
Predators	10	11.8	22	16.8	24	10.1	0	0.0	36	9.9
Unknown	53	62.4	51	38.9	33	13.9	6	40.0	256	70.1

Table 3-7-275. Average number of invertebrates collected from litter by the d-vac method at each sampling site during September 1975 for RBOSP

Site	Vegetation type	# of Samples	Avg. # of inverts. per kilogram litter	Variance	Std. error
1	greasewood-sagebrush	5	348.0	31769.2	79.7
2	pinyon-juniper (south slope)	5	47.0	1642.9	18.1
3	pinyon-juniper (north slope)	5	44.7	2933.4	24.2
4	sagebrush	5	90.9	8746.5	41.8
5	mixed brush	5	687.9	390493.5	279.5

Table 3-7-276 Results of litter d-vac invertebrate sampling at site 1, greasewood-sagebrush, during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted* #	Litter dry Weight (gm)	# of invertebrates per kilogram litter
331	96	96.49	230.00	419.5
332	197	198.00	342.00	578.9
333	69	69.35	536.00	129.4
334	57	57.29	269.00	213.0
335	79	79.40	199.00	399.0

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-277 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by litter D-vac sampling at all sites during September 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5 A	 B
DIPLURA											
Unknown		1	14	0	0	0	0	0	0	0	0
COLLEMBOLA											
Isotomidae	elongate-bodied springtails	0	0	0	0	1	13	0	0	0	0
Entomobryidae	elongate-bodied springtails	0	0	1	3	0	0	0	0	1	53
Sminthuridae	globular springtails	1	2	0	0	0	0	0	0	0	0
PSOCOPTERA											
Unknown		1	217	0	0	1	12	0	0	0	0
Psocidae	psocids	0	0	1	2	0	0	0	0	0	0
THYSANOPTERA											
Unknown		1	2	1	3	1	2	0	0	1	4
HEMIPTERA											
Unknown		1	10	0	0	0	0	1	1	1	4
HOMOPTERA											
Unknown		1	2	1	1	1	1	1	3	0	0
Cicadellidae	leafhoppers	0	0	0	0	0	0	0	0	1	3
COLEOPTERA											
Unknown		0	0	1	9	0	0	0	0	1	13
Carabidae	ground beetles	1	1	0	0	1	5	0	0	1	2
Staphylinidae	rove beetles	2	6	1	1	1	6	0	0	0	0
Cleridae	checkered beetles	1	2	0	0	0	0	1	1	0	0
Lathridiidae	minute brown scavenger beetles	1	2	0	0	0	0	0	0	0	0
Tenebrionidae	darkling beetles	0	0	0	0	1	1	1	2	2	2
Chrysomelidae	leaf beetles	2	12	0	0	0	0	1	11	0	0
Curculionidae	snout beetles	2	2	0	0	2	4	1	1	2	4
LEPIDOPTERA											
Unknown		1	2	0	0	0	0	0	0	1	1
DIPTERA											
Unknown		1	2	1	1	0	0	1	2	0	0
HYMENOPTERA											
Unknown		1	3	0	0	0	0	1	3	2	9
Ceraphronidae	ceraphronid wasps	1	5	0	0	0	0	0	0	0	0
Formicidae	ants	2	19	1	1	2	76	2	4	1	1
CHELONETHIDA	pseudoscorpions										
Unknown		0	0	1	1	1	6	0	0	1	8

Table 3-7-277 (continued)

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5 A	 B
ARANEIDA	spiders										
Unknown		0	0	1	12	2	10	1	1	1	4
Dictynidae	dictynid spiders	0	0	0	0	0	0	0	0	1	1
Gnaphosidae	hunting spiders	1	2	0	0	1	1	1	1	1	9
Thomisidae	crab spiders	1	1	0	0	0	0	0	0	1	2
Salticidae	jumping spiders	0	0	1	0	0	0	1	2	1	4
PHALANGIDA	harvestmen										
Unknown		0	0	0	0	0	0	1	0	0	0
ACARI	ticks and mites										
Unknown		1	186	1	73	1	57	1	27	1	499
GEOPHILOMORPHA											
Unknown		1	6	0	0	0	0	0	0	1	2
TOTALS		25	498	12	107	16	194	15	59	22	630

Table 3-7-278. Numbers and percentages of invertebrates within each feeding type taken in litter D-vac samples at each site during September 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5 #	Site 5 %
Herbivores	18	3.6	4	3.7	7	3.6	15	25.4	11	1.7
Flower feeders	7	1.4	0	0.0	0	0.0	0	0.0	1	0.2
Fungus feeders	2	0.4	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	233	46.8	5	4.7	26	13.4	2	3.4	60	9.5
Omnivores	19	3.8	1	0.9	76	39.2	4	6.8	1	0.2
Predators	18	3.6	14	13.1	28	14.4	5	8.5	32	5.1
Unknown	201	40.4	83	77.6	57	29.4	33	55.9	525	83.3

Table 3-7-279. Results of ground layer herbaceous sweep sampling at each site during June, 1975 for RBOSP

ORDER Family	Common Name	Site 1 A1/	Site 1 B2/	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
COLLEMBOLA											
Sminthuridae	globular springtails	1	3								
ORTHOPTERA											
Acrididae	short horned grasshoppers	1	1			1	1				
THYSANOPTERA	thrips	4	28								
HEMIPTERA											
Miridae	plant bugs	2	4	1	9	1	2			1	8
Lygaeidae	seed bugs	1	1								
Unknown immatures				1	2			1	1		
HOMOPTERA											
Cicadellidae	leafhoppers	4	29	1	2	2	3	1	1	2	4
Cicadellidae imm.	leafhoppers			1	2	1	2				
Delphacidae	delphacid planthoppers	1	1			1	5			1	1
Psyllidae	psyllids			3	6			1	1	1	3
Aphididae	aphids	1	2	1	2						
COLEOPTERA											
Scydmaenidae	antlike stone beetles			1	1						
Cantharidae	soldier beetles					1	1	1	1		
Cleridae	checkered beetles									1	5
Erotylidae	pleasing fungus beetles	1	1							1	1
Lathridiidae	minute brown scavenger beetles	1	1								
Coccinellidae	ladybird beetles			1	1						
Anthicidae	antlike flower beetles	1	8								
Ptinidae	spider beetles			1	2						
Chrysomelidae	leaf beetles	1	2			1	1				
Curculionidae	snout beetles	1	1							3	3
Unknown larvae										1	1

Table 3-7279. (Continued)

ORDER Family	Common Name	Site 1 A[1/]	Site 1 B[2/]	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
LEPIDOPTERA											
Arctiidae larvae	tiger moths									1	1
Geometridae larvae	geometer moths									1	1
DIPTERA											
Empididae	dance flies					1	1				
Pipunculidae	big-headed flies	1	3								
Tephritidae	fruit flies									1	1
Chamaemyiidae	aphid flies			1	2						
Chloropidae	chloropid flies	1	1			1	1	1	3		
Agromyzidae	leaf-miner flies									1	7
Anthomyiidae	anthomyiid flies	1	1								
HYMENOPTERA											
Braconidae	braconid wasps	4	8			1	1			3	3
Ichneumonidae	ichneumonid wasps							1	1		
Mymaridae	fairyflies	1	1								
Eulophidae	eulophid wasps	1	2	3	9			1	2		
Encyrtidae	encyrtid wasps	1	1			1	1	1	1	1	1
Pteromalidae	pteromalid wasps	1	2	2	2	2	2	2	3	1	1
Scelionidae	scelionid wasps	1	1								
Formicidae	ants	4	17	3	7	2	8	3	6	5	8
Colletidae	yellow-faced bees									1	1
ARANEIDA											
Thomisidae	crab spiders	1	4					1	2		
Salticidae	jumping spiders			1	1						
ACARI	ticks & mites	1	4								
		38	127	21	48	16	29	14	22	26	50

1/ A = Number of species groups

2/ Total number of individuals

Table 3-7-280. Percentages of invertebrates within each feeding type in herbaceous sweep samples at all sites during June, 1975 for RBOSP

	Site 1	Site 2	Site 3	Site 4	Site 5
Herbivores	57	48	52	18	48
Flower feeders	13	23	18	45	28
Fungus feeders	2	0	0	0	2
Saprovores	0	2	0	0	0
Omnivores	13	15	28	27	16
Predators	3	4	3	9	0
Unknown	12	8	0	0	6

Table 3-7-281 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by ground layer herbaceous sweep sampling at all sites during July 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5 A	 B
THYSANURA											
Unknown		3	34	1	2	2	2	0	0	0	0
COLLEMBOLA											
Sminthuridae	globular springtails	1	7	1	22	1	5	0	0	1	15
ORTHOPTERA											
Acrididae	short-horned grasshoppers	1	5	0	0	0	0	1	1	1	1
PSOCOPTERA											
Unknown		0	0	0	0	0	0	1	1	0	0
THYSANOPTERA											
Unknown		1	23	0	0	0	0	0	0	2	16
HEMIPTERA											
Unknown		1	1	0	0	0	0	0	0	0	0
Miridae	plant bugs	2	7	1	2	0	0	5	30	11	46
Nabidae	damsel bugs	1	2	0	0	0	0	1	1	0	0
Lygaeidae	seed bugs	1	1	0	0	0	0	1	1	0	0
Cydnidae	burrower bugs	0	0	0	0	0	0	1	2	0	0
HOMOPTERA											
Cicadellidae	leafhoppers	6	112	2	26	4	5	3	37	4	45
Cercopidae	froghoppers	2	4	0	0	1	1	1	1	1	3
Delphacidae	delphacid planthoppers	0	0	0	0	2	3	1	1	0	0
Psyllidae	psyllids	0	0	1	1	0	0	1	2	1	8
Aphididae	aphids	1	2	0	0	0	0	0	0	1	142
COLEOPTERA											
Unknown		0	0	0	0	1	1	0	0	1	1
****		0	0	0	0	0	0	1	9	0	0
Cleridae	checkered beetles	0	0	2	2	0	0	1	4	2	18
Coccinellidae	ladybird beetles	1	1	0	0	1	1	0	0	0	0
Meloidae	blister beetles	0	0	0	0	0	0	1	6	1	1
Chrysomelidae	leaf beetles	1	1	0	0	0	0	0	0	1	8
Curculionidae	snout beetles	1	9	0	0	0	0	0	0	1	20
LEPIDOPTERA											
Geometridae	geometer moths	1	1	0	0	0	0	0	0	0	0
DIPTERA											
Culicidae	mosquitoes	1	3	0	0	0	0	0	0	0	0

Table 3-7-281 (continued)

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
Chironomidae	midges	2	8	0	0	0	0	0	0	0	0
Bibionidae	march flies	0	0	0	0	0	0	1	4	0	0
Asilidae	robber flies	1	1	0	0	0	0	0	0	1	2
Dolichopodidae	long-legged flies	0	0	0	0	0	0	1	1	0	0
Phoridae	humpbacked flies	1	1	0	0	0	0	0	0	0	0
Tephritidae	fruit flies	1	1	0	0	0	0	0	0	1	2
Sepsidae	black scavenger flies	1	2	0	0	0	0	0	0	0	0
Chloropidae	chloropid flies	5	113	1	2	0	0	0	0	1	14
Trixoscelididae	trixoscelidid flies	1	15	0	0	0	0	0	0	0	0
Anthomyiidae	anthomyiid flies	2	3	0	0	0	0	1	2	0	0
Calliphoridae	blow flies	1	1	0	0	0	0	0	0	0	0
Tachinidae	tachinid flies	1	1	0	0	0	0	0	0	0	0
HYMENOPTERA											
Braconidae	braconid wasps	3	8	0	0	0	0	1	1	1	1
Mymaridae	fairyflies	2	4	0	0	1	1	1	1	0	0
Eulophidae	eulophid wasps	4	17	1	4	2	3	0	0	5	8
Encyrtidae	encyrtid wasps	2	3	0	0	2	2	1	1	0	0
Pteromalidae	pteromalid wasps	5	5	1	1	0	0	4	9	4	6
Cynipidae	gall wasps	1	1	0	0	0	0	0	0	3	3
Ceraphronidae	ceraphronid wasps	0	0	0	0	0	0	0	0	1	2
Diapriidae	diapriid wasps	0	0	1	1	0	0	0	0	0	0
Platygasteridae	platygasterid wasps	1	1	0	0	0	0	0	0	1	1
Chrysididae	cuckoo wasps	1	1	0	0	0	0	0	0	0	0
Formicidae	ants	3	16	1	1	3	11	3	10	4	34
ARANEIDA											
Dictynidae	dictynid spiders	1	1	0	0	0	0	1	1	0	0
Tetragnathidae	long-jawed orbweavers	1	2	0	0	0	0	0	0	0	0
Thomisidae	crab spiders	0	0	0	0	0	0	1	2	1	8
Salticidae	jumping spiders	1	1	1	3	0	0	1	5	1	4
ACARI	ticks and mites										
Unknown		0	0	1	13	0	0	0	0	1	30
	TOTALS	66	419	15	80	20	35	35	133	53	439

Table 3-7-282 Numbers and percentages of invertebrates within each feeding type taken in ground layer herbaceous sweep samples at each site during July 1975 for RBOSP

	Site 1		Site 2		Site 3		Site 4		Site 5	
Feeding type	#	%	#	%	#	%	#	%	#	%
Herbivores	165	39.4	51	63.8	14	39.7	90	67.7	290	66.1
Flower feeders	157	37.5	7	8.8	6	17.1	3	2.3	29	6.6
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	45	10.7	2	2.5	2	6.0	1	0.8	15	3.4
Omnivores	16	3.8	1	1.3	11	31.4	10	7.5	34	7.7
Predators	16	3.8	6	7.5	1	2.9	23	17.3	38	8.7
Unknown	20	4.8	13	16.3	1	2.9	6	4.5	33	7.5

Table 3-7-283 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by ground layer herbaceous sweep sampling at all sites during September 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5 A	 B
THYSANURA											
Unknown		1	1	1	3	0	0	0	0	0	0
COLLEMBOLA											
Sminthuridae	globular springtails	0	0	1	2	0	0	1	1	0	0
ORTHOPTERA											
Acrididae	short-horned grasshoppers	1	1	0	0	0	0	0	0	0	0
THYSANOPTERA											
Unknown		0	0	0	0	0	0	1	1	3	62
HEMIPTERA											
Anthocoridae	minute pirate bugs	1	3	0	0	0	0	0	0	0	0
Miridae	plant bugs	3	7	2	4	0	0	1	1	5	38
Nabidae	damsel bugs	1	2	0	0	0	0	1	8	0	0
Lygaeidae	seed bugs	1	106	0	0	0	0	0	0	0	0
Coreidae	leaf-foot bugs	0	0	0	0	0	0	1	1	0	0
HOMOPTERA											
Unknown		0	0	1	3	0	0	0	0	0	0
Cicadellidae	leafhoppers	2	3	5	65	1	7	1	8	4	9
Delphacidae	delphacid planthoppers	1	1	0	0	0	0	0	0	0	0
Issidae	issid planthoppers	0	0	0	0	0	0	1	2	0	0
Psyllidae	psyllids	0	0	1	7	1	72	0	0	1	3
Aphididae	aphids	0	0	1	32	1	5	0	0	1	1306
COLEOPTERA											
Unknown		0	0	0	0	0	0	0	0	1	2
Cleridae	checkered beetles	0	0	2	5	0	0	1	1	1	3
Lathridiidae	minute brown scavenger beetles	1	1	0	0	0	0	0	0	0	0
Coccinellidae	ladybird beetles	0	0	0	0	0	0	1	1	2	2
Melandryidae	false darkling beetles	0	0	0	0	0	0	0	0	1	2
Chrysomelidae	leaf beetles	4	6	1	3	0	0	0	0	1	1
Curculionidae	snout beetles	2	2	2	2	0	0	1	6	1	13
NEUROPTERA											
Chrysopidae	green lacewings	0	0	0	0	0	0	0	0	2	4
LEPIDOPTERA											
Unknown		1	1	0	0	0	0	0	0	0	0
Gracilariidae	leaf blotch miners	0	0	0	0	0	0	0	0	1	5

Table 3-7-283 (continued)

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
DIPTERA											
Unknown		0	0	0	0	0	0	0	0	1	1
Tipulidae	crane flies	0	0	0	0	0	0	0	0	1	1
Chironomidae	midges	0	0	1	1	0	0	0	0	0	0
Sciaridae	dark-winged fungus gnats	0	0	1	1	0	0	0	0	0	0
Cecidomyiidae	gall midges	0	0	0	0	0	0	1	1	0	0
Therevidae	stiletto flies	0	0	1	1	0	0	0	0	1	1
Phoridae	humpbacked flies	0	0	0	0	1	1	0	0	1	1
Pipunculidae	big-headed flies	0	0	0	0	1	1	0	0	0	0
Tephritidae	fruit flies	1	3	0	0	1	1	0	0	1	4
Sepsidae	black scavenger flies	1	1	0	0	0	0	0	0	1	3
Chloropidae	chloropid flies	2	10	1	1	1	1	0	0	2	5
Trixoscelididae	trixoscelidid flies	1	1	0	0	1	1	0	0	0	0
Anthomyiidae	anthomyiid flies	0	0	0	0	0	0	1	1	2	2
Tachinidae	tachinid flies	1	1	0	0	0	0	0	0	0	0
HYMENOPTERA											
Braconidae	braconid wasps	2	4	2	3	0	0	0	0	4	17
Ichneumonidae	ichneumonid wasps	2	3	0	0	0	0	0	0	0	0
Eulophidae	eulophid wasps	1	1	2	8	1	1	2	3	10	20
Encyrtidae	encyrtid wasps	1	6	0	0	0	0	0	0	1	3
Eupelmidae	eupelmid wasps	0	0	0	0	0	0	0	0	1	1
Pteromalidae	pteromalid wasps	3	5	4	5	0	0	2	4	3	47
Cynipidae	gall wasps	1	1	0	0	0	0	0	0	2	10
Platygasteridae	platygasterid wasps	2	2	1	3	0	0	1	5	2	10
Formicidae	ants	0	0	3	5	0	0	2	3	2	24
Halictidae	halictid bees	1	1	0	0	0	0	0	0	0	0
ARANEIDA											
Thomisidae	crab spiders	0	0	1	1	0	0	0	0	1	9
Salticidae	jumping spiders	0	0	1	1	0	0	1	30	1	3
ACARI	ticks and mites										
Unknown		0	0	0	0	0	0	0	0	1	3
	TOTALS	38	173	35	156	9	90	20	77	62	1615

3-7-786

Table 3-7-284 Numbers and percentages of invertebrates within each feeding type taken in ground layer herbaceous sweep samples at each site during September 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5 #	Site 5 %
Herbivores	126	72.8	117	75.0	84	93.3	19	24.7	1435	88.9
Flower feeders	30	17.3	17	10.9	2	2.2	8	10.4	72	4.5
Fungus feeders	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	2	1.2	5	3.2	1	1.1	1	1.3	4	0.2
Omnivores	0	0.0	5	3.2	0	0.0	3	3.9	24	1.5
Predators	10	5.8	12	7.7	0	0.0	44	57.1	68	4.2
Unknown	4	2.3	0	0.0	3	3.3	2	2.6	12	0.7

Table 3-7-285. Results of beating samples from plant species at sites 1, 2, and 3 during June, 1975 for RBOSP

ORDER Family	Common Name	Site 1 Greasewood-sage A[1/]	Site 1 Greasewood-sage B[2/]	Site 2 Pinyon A	Site 2 Pinyon B	SOUTH Juniper A	SOUTH Juniper B	Site 3 Pinyon A	Site 3 Pinyon B	NORTH Juniper A	NORTH Juniper B
ORTHOPTERA											
Acrididae	short-horned grasshoppers	1	1								
THYSANOPTERA	thrips	2	2								
HEMIPTERA											
Miridae	plant bugs	1	5			1	105			1	4
Reduviidae	assassin bug							1	3		
Unknown		1	1					1	2		
HOMOPTERA											
Cicadellidae immature	leafhoppers	2	8								
Aphididae	aphids	1	6	1	3						
Coccoidea (superfamily)	scale insects							1	1		
COLEOPTERA											
Coccinellidae	ladybird beetles	1	1	1	1					1	1
Anthicidae	antlike flower beetles	1	2			1	2				
Meloidae	blister beetles					1	1				
Chrysomelidae	leaf beetles									1	2
Curculionidae	snout beetles	2	2							1	3
Scolytidae	bark beetles			1	2						
Unknown		1	1			1	2				
LEPIDOPTERA	butterflies and moths	1	2			1	2				
HYMENOPTERA											
Ichneumonidae	ichneumonid wasps									1	1
Eulophidae	eulophid wasps	1	1								
Figitidae	figitid wasps	1	1								
Platygasteridae	platygasterid wasps	1	1								
Formicidae	ants	2	4	2	16						

Table 3-7-285. (Continued)

ORDER Family	Common Name	Site 1 Greasewood-sage A1/	B2/	Site 2 Pinyon A	B	SOUTH Juniper A	B	Site 3 Pinyon A	B	NORTH Juniper A	B
ARANEIDA											
Dictynidae	dictynid spiders					1	3		1	1	2
Araneidae	orb-weaver spiders			1	2	1	1		1		
Oxyopidae	lynx spiders					1	2				
Thomisidae	crab spiders				1	1	1		3	1	1
Salticidae	jumping spiders		2	1	1	1	1			1	2
ACARI		1	8	1	6	1	2	1	1	1	1
	TOTALS	20	48	8	32	11	122	4	12	9	17

1/ A = Number of species groups

2/ B = Total number of individuals

Table 3-7-286. Percentages of invertebrates within each feeding type taken in beating samples from plant species at sites 1, 2, and 3 during June, 1975 for RBOSP

	Site 1	Site 2		Site 3	
	Sage	Pinyon	Juniper	Pinyon	Juniper
Herbivores	52	15	87	25	53
Flower feeders	8	0	2	0	6
Fungus feeders	0	0	0	0	0
Saprovores	0	0	0	0	0
Omnivores	8	50	0	0	0
Predators	6	15	7	67	35
Unknown	26	20	4	8	6

Table 3-7-287 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by beating sampling at all sites during July 1975 for RBOSP

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2P A	Site 2P B	Site 2J A	Site 2J B	Site 3P A	Site 3P B	Site 3J A	Site 3J B
COLLEMBOLA											
Sminthuridae	globular springtails	0	0	1	7	1	31	0	0	0	0
PSOCOPTERA											
Unknown		0	0	0	0	1	2	0	0	1	2
THYSANOPTERA											
Unknown		3	98	2	34	0	0	2	16	1	1
HEMIPTERA											
Unknown		0	0	1	44	1	13	1	51	0	0
Anthocoridae	minute pirate bugs	1	8	0	0	0	0	0	0	0	0
Miridae	plant bugs	8	255	0	0	0	0	0	0	2	5
Lygaeidae	seed bugs	1	2	0	0	0	0	0	0	0	0
HOMOPTERA											
Cicadellidae	leafhoppers	5	253	1	6	2	2	1	14	1	1
Psyllidae	psyllids	0	0	0	0	2	9	0	0	0	0
Aphididae	aphids	2	63	1	2	0	0	1	12	0	0
COLEOPTERA											
Unknown		2	2	1	1	0	0	0	0	0	0
Cleridae	checkered beetles	0	0	1	16	1	3	0	0	0	0
Elateridae	click beetles	0	0	0	0	0	0	1	1	0	0
Coccinellidae	ladybird beetles	1	3	1	1	0	0	0	0	0	0
Curculionidae	snout beetles	2	2	0	0	1	3	1	6	2	8
NEUROPTERA											
Hemerobiidae	brown lacewings	0	0	0	0	0	0	1	1	0	0
LEPIDOPTERA											
Unknown		1	3	0	0	1	2	1	2	0	0
DIPTERA											
Culicidae	mosquitoes	0	0	1	1	0	0	0	0	0	0
Chloropidae	chloropid flies	1	1	0	0	0	0	0	0	0	0
HYMENOPTERA											
Braconidae	braconid wasps	0	0	1	1	1	1	3	3	0	0
Eulophidae	eulophid wasps	0	0	2	4	1	1	1	2	0	0
Encyrtidae	encyrtid wasps	2	2	1	1	2	2	0	0	1	1
Eupelmidae	eupelmid wasps	0	0	1	1	1	2	0	0	1	1

Table 3-7-287 (continued)

ORDER Family	Common name	Site 1 A	 B	Site 2P A	 B	Site 2J A	 B	Site 3P A	 B	Site 3J A	 B
Pteromalidae	pteromalid wasps	0	0	2	2	0	0	1	2	0	0
Figitidae	figitid wasps	0	0	1	1	0	0	0	0	0	0
Cynipidae	gall wasps	0	0	0	0	1	1	0	0	0	0
Diapriidae	diapriid wasps	0	0	0	0	1	1	1	1	0	0
Scelionidae	scelionid wasps	0	0	3	3	0	0	0	0	0	0
Platygasteridae	platygasterid wasps	0	0	0	0	0	0	1	3	1	1
Formicidae	ants	2	7	2	6	0	0	2	3	1	1
ARANEIDA	spiders										
Unknown		0	0	0	0	0	0	1	1	0	0
Dictynidae	dictynid spiders	1	3	1	2	1	10	1	4	1	5
Oxyopidae	lynx spiders	0	0	0	0	0	0	1	1	0	0
Thomisidae	crab spiders	1	1	1	7	1	1	1	1	0	0
Salticidae	jumping spiders	1	6	1	2	1	1	0	0	0	0
ACARI	ticks and mites										
Unknown		1	68	0	0	1	12	0	0	1	9
	TOTALS	35	777	26	142	21	97	22	124	13	35

Table 3-7- 288. Numbers and percentages of invertebrates within each feeding type taken in beating samples at each site during July 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2P #	Site 2P %	Site 2J #	Site 2J %	Site 3P #	Site 3P %	Site 3J #	Site 3J %
Herbivores	621	79.9	93	65.2	59	60.7	100	80.6	15	42.9
Flower feeders	58	7.5	11	7.7	9	9.3	11	8.9	3	8.6
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	0	0.0	0	0.0	2	2.1	0	0.0	2	5.7
Omnivores	7	0.9	6	4.2	0	0.0	3	2.4	1	2.9
Predators	21	2.7	31	21.8	15	15.5	10	8.1	5	14.3
Unknown	70	9.0	1	1.0	12	12.2	0	0.0	9	25.7

Table 3-7-289. Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by beating sampling at all sites during September 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2P A	 B	Site 2J A	 B	Site 3P A	 B	Site 3J A	 B
COLLEMBOLA											
Sminthuridae	globular springtails	1	3	1	47	1	2	0	0	1	2
PSOCOPTERA											
Unknown		0	0	1	1	0	0	0	0	2	16
THYSANOPTERA											
Unknown		2	25	3	6	2	2	1	1	0	0
HEMIPTERA											
Anthocoridae	minute pirate bugs	1	2	0	0	0	0	0	0	0	0
Miridae	plant bugs	2	45	1	6	2	2	1	1	0	0
Reduviidae	assassin bugs	0	0	0	0	0	0	3	6	1	1
HOMOPTERA											
Unknown		1	3	1	2	0	0	0	0	0	0
Cicadellidae	leafhoppers	3	22	1	1	0	0	0	0	0	0
Cercopidae	froghoppers	0	0	0	0	0	0	1	1	0	0
Psyllidae	psyllids	0	0	1	2	0	0	0	0	1	1
Aphididae	aphids	1	47	1	6	0	0	1	1	0	0
COLEOPTERA											
Unknown		0	0	0	0	0	0	0	0	1	1
Coccinellidae	ladybird beetles	0	0	0	0	0	0	2	2	0	0
Anthicidae	antlike flower beetles	0	0	1	1	0	0	0	0	0	0
Chrysomelidae	leaf beetles	0	0	0	0	1	1	0	0	0	0
Curculionidae	snout beetles	0	0	0	0	0	0	1	1	0	0
NEUROPTERA											
Hemerobiidae	brown lacewings	0	0	0	0	0	0	1	1	0	0
Chrysopidae	green lacewings	0	0	0	0	0	0	0	0	1	1
HYMENOPTERA											
Diprionidae	conifer sawflies	0	0	0	0	1	2	0	0	0	0
Braconidae	braconid wasps	0	0	0	0	0	0	0	0	1	1
Eulophidae	eulophid wasps	0	0	1	1	0	0	0	0	1	1
Encyrtidae	encyrtid wasps	0	0	1	1	0	0	0	0	1	1
Pteromalidae	pteromalid wasps	0	0	0	0	1	1	0	0	0	0
ARANEIDA	spiders										
Unknown		0	0	1	4	0	0	1	5	0	0
Dictynidae	dictynid spiders	1	1	1	5	1	3	1	2	1	3

Table 3-7-289 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by beating sampling at all sites during September 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2P A	 B	Site 2J A	 B	Site 3P A	 B	Site 3J A	 B
COLLEMBOLA											
Sminthuridae	globular springtails	1	3	1	47	1	2	0	0	1	2
PSOCOPTERA											
Unknown		0	0	1	1	0	0	0	0	2	16
THYSANOPTERA											
Unknown		2	25	3	6	2	2	1	1	0	0
HEMIPTERA											
Anthocoridae	minute pirate bugs	1	2	0	0	0	0	0	0	0	0
Miridae	plant bugs	2	45	1	6	2	2	1	1	0	0
Reduviidae	assassin bugs	0	0	0	0	0	0	3	6	1	1
HOMOPTERA											
Unknown		1	3	1	2	0	0	0	0	0	0
Cicadellidae	leafhoppers	3	22	1	1	0	0	0	0	0	0
Cercopidae	froghoppers	0	0	0	0	0	0	1	1	0	0
Psyllidae	psyllids	0	0	1	2	0	0	0	0	1	1
Aphididae	aphids	1	47	1	6	0	0	1	1	0	0
COLEOPTERA											
Unknown		0	0	0	0	0	0	0	0	1	1
Coccinellidae	ladybird beetles	0	0	0	0	0	0	2	2	0	0
Anthicidae	antlike flower beetles	0	0	1	1	0	0	0	0	0	0
Chrysomelidae	leaf beetles	0	0	0	0	1	1	0	0	0	0
Curculionidae	snout beetles	0	0	0	0	0	0	1	1	0	0
NEUROPTERA											
Hemerobiidae	brown lacewings	0	0	0	0	0	0	1	1	0	0
Chrysopidae	green lacewings	0	0	0	0	0	0	0	0	1	1
HYMENOPTERA											
Diprionidae	conifer sawflies	0	0	0	0	1	2	0	0	0	0
Braconidae	braconid wasps	0	0	0	0	0	0	0	0	1	1
Eulophidae	eulophid wasps	0	0	1	1	0	0	0	0	1	1
Encyrtidae	encyrtid wasps	0	0	1	1	0	0	0	0	1	1
Pteromalidae	pteromalid wasps	0	0	0	0	1	1	0	0	0	0
ARANEIDA	spiders										
Unknown		0	0	1	4	0	0	1	5	0	0
Dictynidae	dictynid spiders	1	1	1	5	1	3	1	2	1	3

Table 3-7-289. (continued)

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2P A	Site 2P B	Site 2J A	Site 2J B	Site 3P A	Site 3P B	Site 3J A	Site 3J B
Oxyopidae	lynx spiders	0	0	0	0	0	0	0	0	1	1
Gnaphosidae	hunting spiders	0	0	1	5	0	0	0	0	1	1
Thomisidae	crab spiders	1	1	1	2	0	0	1	3	1	1
Salticidae	jumping spiders	1	2	1	2	0	0	1	3	0	0
ACARI	ticks and mites	1	22	0	0	1	3	0	0	0	0
Unknown											
	TOTALS	15	173	18	92	10	16	15	27	14	31

Table 3-7-290. Results of aerial sweep samples from plant species at sites 1, 2, and 3 during June, 1975 for RBOSP

		Site 1		Site 2 SOUTH				Site 3 NORTH			
		Sagebrush		Pinyon		Juniper		Pinyon		Juniper	
ORDER Family	Common Name	A1/	B2/	A	B	A	B	A	B	A	B
COLLEMBOLA											
Sminthuridae	globular springtails					1	5				
THYSANOPTERA	thrips	2	17								
HEMIPTERA											
Miridae immature	plant bugs	1	55	1	1	1	74			1	12
Unknownimmature		1	3								
HOMOPTERA											
Psyllidae	psyllids	1	2								
COLEOPTERA											
Coccinellidae	ladybird beetles	1	3	1	1						
Meloidae	blister beetles			1	1						
Chrysomelidae	leaf beetles	1	1								
Curculionidae	Snout beetles			1	1						
LEPIDOPTERA						1	1				
DIPTERA											
Chironomidae	midges	1	1								
Asilidae	robber flies					1	1				
Tephritidae	fruit flies									1	1
Agromyzidae	leaf-miner flies	2	4			1	1				
Anthomyiidae	anthomyiid flies			1	1						
HYMENOPTERA											
Braconidae	braconid wasps	2	5	1	1						
Ichneumonidae	ichneumonid wasps	1	1								

Table 3-7-290. (Continued)

ORDER Family	Common Name	Site 1 Sagebrush A1/	B2/	Site 2 Pinyon A	B	SOUTH Juniper A	B	Site 3 Pinyon A	B	NORTH Juniper A	B
HYMENOPTERA (Cont.)											
Eulophidae	eulophid wasps					2	2				
Pteromalidae	pteromalid wasps	3	3								
Formicidae	ants					1	1	1	3		
ARANEIDA											
Araneidae	orb-weaver spiders			1	1					1	1
Thomisidae	crab spiders	1	2					1	1	1	2
Salticidae	jumping spiders	1	3					1	1	1	3
Unknown										1	1
	TOTALS	18	100	7	7	8	85	3	5	6	20

1/ A = Number of species groups

2/ B = Total number of individuals

Table 3-7-291. Percentages of invertebrates within each feeding type taken in aerial sweep samples from plant species at sites 1, 2, and 3 during June, 1975 for RBOSP

	Site 1	Site 2		Site 3	
	Sage	Pinyon	Juniper	Pinyon	Juniper
Herbivores	78	28	95	0	60
Flower feeders	13	28	3	0	0
Saprovores	1	0	0	0	0
Omnivores	0	0	1	60	0
Predators	8	43	1	40	35
Unknown	0	0	0	0	5

Table 3-7-292 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by aerial sweep sampling at all sites during July 1975 for RBOSP

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2P A	Site 2P B	Site 2J A	Site 2J B	Site 3P A	Site 3P B	Site 3J A	Site 3J B
COLLEMBOLA											
Unknown		1	2	0	0	0	0	0	0	0	0
Sminthuridae	globular springtails	0	0	1	1	1	7	0	0	0	0
PSOCOPTERA											
Unknown		0	0	1	1	0	0	1	2	0	0
THYSANOPTERA											
Unknown		3	42	0	0	0	0	1	2	1	1
HEMIPTERA											
Anthocoridae	minute pirate bugs	1	20	0	0	0	0	0	0	0	0
Miridae	plant bugs	8	39	1	3	2	6	3	5	1	2
Nabidae	damsel bugs	1	1	0	0	0	0	0	0	0	0
Pentatomidae	stink bugs	0	0	0	0	0	0	1	3	0	0
HOMOPTERA											
Cicadellidae	leafhoppers	2	126	1	1	1	1	1	3	0	0
Delphacidae	delphacid planthoppers	1	1	0	0	0	0	0	0	0	0
Psyllidae	psyllids	2	4	0	0	0	0	0	0	0	0
Aphididae	aphids	1	7	1	1	0	0	2	7	1	1
COLEOPTERA											
Cleridae	checkered beetles	0	0	2	10	2	2	2	5	1	1
Coccinellidae	ladybird beetles	2	9	1	1	0	0	1	3	0	0
Chrysomelidae	leaf beetles	0	0	0	0	0	0	1	1	1	2
Curculionidae	snout beetles	1	4	0	0	1	1	0	0	1	4
NEUROPTERA											
Myrmeleontidae	antlions	0	0	0	0	0	0	0	0	1	1
LEPIDOPTERA											
Unknown		0	0	1	1	1	1	1	3	0	0
DIPTERA											
Cecidomyiidae	gall midges	0	0	0	0	0	0	1	1	0	0
Asilidae	robber flies	0	0	0	0	0	0	0	0	1	1
Tephritidae	fruit flies	1	1	0	0	0	0	0	0	0	0
Chloropidae	chloropid flies	1	2	0	0	0	0	1	1	0	0
HYMENOPTERA											
Braconidae	braconid wasps	2	2	1	1	1	1	0	0	1	1
Mymaridae	fairyflies	1	1	0	0	0	0	0	0	1	1

Table 3-7-292 (continued)

ORDER Family	Common name	Site 1 A	 B	Site 2P A	 B	Site 2J A	 B	Site 3P A	 B	Site 3J A	 B
Eulophidae	eulophid wasps	4	4	2	6	1	4	4	4	1	2
Encyrtidae	encyrtid wasps	1	1	0	0	1	4	0	0	2	2
Eupelmidae	eupelmid wasps	0	0	0	0	0	0	0	0	2	2
Pteromalidae	pteromalid wasps	2	2	1	1	2	5	5	5	3	3
Scelionidae	scelionid wasps	2	2	1	1	1	2	0	0	0	0
Platygasteridae	platygasterid wasps	1	2	0	0	1	1	1	3	0	0
Formicidae	ants	2	5	1	3	0	0	1	1	0	0
ARANEIDA											
Dictynidae	dictynid spiders	0	0	0	0	0	0	0	0	1	1
Oxyopidae	lynx spiders	0	0	0	0	0	0	1	3	0	0
Thomisidae	crab spiders	1	13	0	0	1	2	0	0	0	0
Salticidae	jumping spiders	1	5	0	0	0	0	0	0	0	0
ACARI	ticks and mites										
Unknown		1	5	0	0	1	2	0	0	0	0
TOTALS		43	300	15	31	17	39	28	52	19	25

Table 3-7-293. Numbers and percentages of invertebrates within each feeding type taken in aerial sweep samples at each site during July 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2P #	Site 2P %	Site 2J #	Site 2J %	Site 3P #	Site 3P %	Site 3J #	Site 3J %
Herbivores	223	74.3	5	16.1	17	43.5	21	40.4	10	40.0
Flower feeders	14	4.7	9	29.0	13	33.3	11	21.2	9	36.0
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	2	0.7	2	6.5	0	0.0	2	3.8	0	0.0
Omnivores	5	1.7	3	9.7	0	0.0	1	1.9	0	0.0
Predators	50	16.7	12	38.7	7	17.9	16	30.8	6	24.0
Unknown	6	2.0	0	0.0	2	5.1	1	1.9	0	0.0

Table 3-7-294 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by aerial sweep sampling at all sites during September 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2P A	 B	Site 2J A	 B	Site 3P A	 B	Site 3J A	 B
COLLEMBOLA											
Sminthuridae	globular springtails	0	0	1	1	1	2	0	0	0	0
THYSANOPTERA											
Unknown		2	34	1	1	0	0	0	0	0	0
HEMIPTERA											
Anthocoridae	minute pirate bugs	1	1	0	0	0	0	0	0	0	0
Miridae	plant bugs	1	42	2	13	2	18	2	9	1	7
Reduviidae	assassin bugs	0	0	0	0	0	0	0	0	1	1
HOMOPTERA											
Unknown		0	0	1	1	0	0	0	0	0	0
Cicadellidae	leafhoppers	3	26	2	3	1	1	1	1	1	1
Cercopidae	froghoppers	0	0	1	2	1	14	0	0	0	0
Psyllidae	psyllids	0	0	0	0	1	1	1	1	0	0
Aphididae	aphids	1	24	1	3	0	0	0	0	0	0
COLEOPTERA											
Cleridae	checkered beetles	0	0	1	1	0	0	0	0	0	0
Coccinellidae	ladybird beetles	1	2	0	0	0	0	0	0	1	1
NEUROPTERA											
Unknown		0	0	0	0	0	0	0	0	1	1
Chrysopidae	green lacewings	0	0	1	1	0	0	0	0	0	0
LEPIDOPTERA											
Unknown		1	1	1	1	0	0	0	0	0	0
Geometridae	geometer moths	0	0	0	0	1	1	1	1	1	2
DIPTERA											
Therevidae	stiletto flies	0	0	1	1	0	0	0	0	0	0
Phoridae	humpbacked flies	0	0	0	0	1	1	0	0	0	0
Anthomyiidae	anthomyiid flies	0	0	1	1	0	0	0	0	0	0
HYMENOPTERA											
Braconidae	braconid wasps	1	5	1	1	0	0	0	0	0	0
Eulophidae	eulophid wasps	1	1	2	4	0	0	0	0	1	7
Encyrtidae	encyrtid wasps	1	1	0	0	2	2	0	0	0	0
Pteromalidae	pteromalid wasps	3	9	1	1	2	2	5	6	2	5
Chalcididae	chalcid wasps	0	0	0	0	0	0	1	1	0	0
Cynipidae	gall wasps	1	5	0	0	0	0	0	0	0	0

Table 3-7-294 (continued)

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2P A	Site 2P B	Site 2J A	Site 2J B	Site 3P A	Site 3P B	Site 3J A	Site 3J B
Proctotrupidae	prototrupid wasps	0	0	1	1	0	0	0	0	1	1
Ceraphronidae	ceraphronid wasps	1	1	0	0	0	0	0	0	0	0
Scelionidae	scelionid wasps	1	1	0	0	0	0	0	0	0	0
Platygasteridae	platygasterid wasps	1	16	0	0	0	0	0	0	0	0
Formicidae	ants	0	0	1	1	0	0	0	0	0	0
ARANEIDA											
Dictynidae	dictynid spiders	0	0	0	0	0	0	1	2	1	1
Oxyopidae	lynx spiders	0	0	0	0	0	0	0	0	1	2
Thomisidae	crab spiders	1	2	1	1	0	0	0	0	0	0
Salticidae	jumping spiders	1	1	0	0	1	1	1	3	0	0
	TOTALS	22	172	21 -	38	13	43	13	24	12	29

Table 3-7-295. Numbers and percentages of invertebrates within each feeding type taken in aerial sweep samples at each site during September 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2P #	Site 2P %	Site 2J #	Site 2J %	Site 3P #	Site 3P %	Site 3J #	Site 3J %
Herbivores	126	73.3	24	63.2	36	83.7	12	50.0	8	27.6
Flower feeders	31	18.0	6	15.8	3	7.0	1	4.2	10	34.5
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	0	0.0	1	2.6	1	2.3	0	0.0	0	0.0
Omnivores	0	0.0	1	2.6	0	0.0	0	0.0	0	0.0
Predators	15	8.7	4	10.5	3	7.0	11	45.8	11	38.0
Unknown	0	0.0	2	5.3	0	0.0	0	0.0	0	0.0

Table 3-7-296. Results of Malaise trap sampling at each site during June, 1975 for RBOSP

ORDER Family	Common Name	Site 1 A1/	Site 1 B2/	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
PSOCOPTERA											
Trogiidae	booklice	1	4								
HEMIPTERA											
Miridae	plant bugs	1	31			1	8	1	4		
Lygaeidae	seed bugs	1	5								
Pentatomidae	stink bugs	1	1								
Unknown nymphs				1	4						
HOMOPTERA											
Membracidae	treehoppers	1	1								
Cicadellidae	leafhoppers	5	30	2	20	2	8	4	16	1	4
Delphacidae	delphacid planthoppers	1	1					1	4		
Psyllidae	psyllids	2	11	2	20			1	12	2	12
Aphidae	aphids	1	3								
COLEOPTERA											
Staphylinidae	rove beetles	2	5								
Scydmaenidae	antlike stone beetles			1	8						
Cantharidae	soldier beetles			1	4			1	4		
Lampyridae	fireflies	1	1								
Ostomidae	bark-gnawing beetles			1	4						
Cleridae	checkered beetles	1	1	1	4	1	12	1	8	1	4
Elateridae	click beetles									1	4
Lathridiidae	minute brown scavenger beetles	1	1								
Coccinellidae	ladybird beetles	2	31	1	4			1	4		
Anthicidae	antlike flower beetles	1	22								
Tenebrionidae	darkling beetles	1	2								
Chrysomelidae	leaf beetles			3	12	1	4	1	4		
Curculionidae	snout beetles	2	25								
NEUROPTERA											
Hemerobiidae	brown lace wings	1	1	1	4						

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Table 3-7-296. (Continued)

ORDER Family	Common Name	Site 1 A1/	Site 1 B2/	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
LEPIDOPTERA											
Hesperidae	skippers	1	1								
Unknown adults		1	53	1	147	1	32	1	80	1	28
DIPTERA											
Tipulidae	crane flies	1	1								
Psychodidae	moth flies	1	12								
Chironomidae	midges	3	984	2	93	2	64	2	140	2	160
Simulidae	black flies	1	9	1	4					1	4
Bibionidae	march flies	2	28								
Mycetophilidae	fungus gnats	1	5	1	24	1	36				
Sciaridae	dark-winged fungus gnats	1	63	4	133	1	36	2	116	1	28
Cecidomyiidae	gall midges	3	274	1	76	1	36	1	92	1	32
Therevidae	stiletto flies	1	13	2	12	1	60			1	4
Asilidae	robber flies	2	12	2	5	1	8				
Dolichopodidae	long-legged flies	1	1								
Phoridae	humpbacked flies	1	45	1	16	1	8			1	12
Pipunculidae	big-headed flies	1	116	1	16						
Syrphidae	syrphid flies	3	195	3	24			1	28	2	8
Otitidae	picture-winged flies	1	1								
Tephritidae	fruit flies	1	4								
Sepsidae	black scavenger flies	1	4								
Sciomyzidae	marsh flies			1	1						
Lauxaniidae	lauxaniid flies										
Chamaemyiidae	aphid flies	1	121	1	84						
Lonchaeidae	lonchaeid flies					1	16			1	32
Chloropidae	chloropid flies	4	22			1	4				
Holeomyzidae	helomyzid flies			1	2						
Trixoscelididae	trixoscelidid flies	1	122	1	16	1	12			1	8
Anthomyiidae	anthomyiid	5	421	4	145					2	8
Muscidae	house flies	1	12								
Calliphoridae	blow flies	1	83							1	4
Tachinidae	tachinid flies	3	31	5	32			1	20		

Table 3-7-296. (Continued)

ORDER Family	Common Name	Site 1 A[1/]	Site 1 B[2/]	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
HYMENOPTERA											
Xyelidae	xyelid sawflies									1	4
Tenthredinidae	common sawflies			1	4						
Braconidae	braconid wasps	7	74	5	20	3	24	1	4	4	20
Ichneumonidae	ichneumonid wasps	11	209	6	34	2	12	6	32	3	20
Mymaridae	fairyflies			1	8						
Eulophidae	eulophid wasps	3	5	4	26	2	8	1	4		
Encyrtidae	encyrtid wasps	2	5								
Pteromalidae	pteromalid wasps	3	34	4	18	2	8	1	4	1	4
Chalcididae	chalcidid wasps	1	1	1	1						
Cynipidae	gall wasps	1	26								
Proctotrupidae	proctotrupid wasps	1	4								
Diapriidae	diapriid wasps	1	4								
Platygasteridae	platygasterid wasps	1	6								
Bethylidae	bethylid wasps									1	4
Formicidae	ants			1	4						
Vespidae	paper wasps	2	9								
Sphecidae	sphecid wasps	1	1								
Colletidae	yellow-faced bees	2	2								
Andrenidae	andrenid bees	1	1	2	5	4	28	1	4	1	4
Halictidae	halictid bees	4	65	2	34	2	8	2	8		
Apidae	bumble bees, honey bees	2	2	1	9	5	36	1	4	—	—
	ACTUAL TOTAL	111	3254	74	1077	37	468	32	592	31	408
	ADJUSTED TOTAL	111	5206	74	2872	37	7488	32	4736	31	6528

1/ A = Number of species groups

2/ B = Total number of individuals

Table 3-7-297. Percent invertebrates taken within each feeding type in Malaise trap samples at all sites during June, 1975 for RBOSP

	Site 1	Site 2	Site 3	Site 4	Site 5
Herbivores	4	7	17	11	5
Flower feeders	66	69	62	74	70
Fungus feeders	0	0	0	0	0
Saprovores	4	2	2	0	4
Omnivores	0	0	0	0	0
Predators	3	4	3	3	2
Unknown	21	18	14	12	19

Table 3-7-298. Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by Malaise trap sampling at all sites during July 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5 A	 B
ORTHOPTERA											
Acrididae	short-horned grasshoppers	0	0	1	4	0	0	0	0	0	0
PSOCOPTERA											
Trogiidae	psocids	1	32	0	0	0	0	0	0	0	0
HEMIPTERA											
Unknown		1	116	1	12	0	0	1	80	0	0
HOMOPTERA											
Unknown		0	0	2	64	0	0	1	608	0	0
Cicadellidae	leafhoppers	1	524	0	0	0	0	0	0	0	0
Aphididae	aphids	1	52	0	0	0	0	0	0	0	0
COLEOPTERA											
Unknown		0	0	0	0	0	0	1	96	0	0
Cleridae	checkered beetles	0	0	3	20	3	16	1	8	0	0
Buprestidae	metallic wood-boring beetles	0	0	0	0	1	4	0	0	0	0
Coccinellidae	ladybird beetles	2	140	1	4	1	4	1	4	0	0
Anthicidae	antlike flower beetles	1	132	0	0	0	0	0	0	0	0
Scarabaeidae	scarab beetles	0	0	0	0	2	16	0	0	0	0
Curculionidae	snout beetles	1	32	0	0	0	0	0	0	0	0
NEUROPTERA											
Hemerobiidae	brown lacewings	0	0	1	4	0	0	0	0	0	0
Myrmeleontidae	antlions	0	0	0	0	0	0	2	16	0	0
Raphidiidae	raphidiid snakeflies	0	0	0	0	1	8	0	0	0	0
LEPIDOPTERA											
Unknown		2	160	2	176	2	224	2	472	2	288
Pieridae	sulphurs, whites, and orange tips	0	0	0	0	0	0	1	4	0	0
Satyridae	satyrs and wood nymphs	0	0	0	0	1	4	0	0	0	0
Nymphalidae	brush-footed butterflies	0	0	0	0	0	0	1	8	0	0
Lycaenidae	gossamer-winged butterflies	0	0	0	0	1	12	0	0	1	8
Lasiocampidae	tent caterpillars and lappet moths	0	0	1	12	0	0	1	4	1	4
DIPTERA											
Tipulidae	crane flies	0	0	0	0	0	0	0	0	1	4
Culicidae	mosquitoes	1	28	0	0	1	4	0	0	0	0
Chironomidae	midges	2	392	1	12	2	84	2	172	2	212
Simuliidae	black flies	0	0	0	0	0	0	0	0	1	8

Table 3-7-298. (continued)

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
Mycetophilidae	fungus gnats	1	16	0	0	0	0	1	12	1	20
Sciaridae	dark-winged fungus gnats	1	80	1	4	1	4	1	16	1	48
Cecidomyiidae	gall midges	2	112	1	104	1	156	1	160	2	56
Therevidae	stiletto flies	1	4	1	16	1	20	1	16	2	8
Asilidae	robber flies	2	12	2	12	2	12	1	4	3	20
Acroceridae	small-headed flies	0	0	0	0	0	0	1	4	0	0
Bombyliidae	bee flies	3	68	1	4	2	20	2	12	1	8
Dolichopodidae	long-legged flies	2	16	0	0	1	4	1	4	0	0
Phoridae	humpbacked flies	1	88	1	4	1	24	1	12	1	48
Pipunculidae	big-headed flies	0	0	1	8	1	12	1	36	1	24
Syrphidae	syrphid flies	1	28	1	8	0	0	0	0	1	12
Psilidae	rust flies	0	0	0	0	0	0	1	8	0	0
Tephritidae	fruit flies	0	0	1	4	0	0	1	4	1	8
Sepsidae	black scavenger flies	0	0	0	0	1	4	0	0	1	92
Chamaemyiidae	aphid flies	1	84	1	12	1	8	1	68	0	0
Lonchaeidae	lonchaeid flies	0	0	0	0	0	0	0	0	1	92
Chloropidae	chloropid flies	4	272	1	12	3	44	5	124	0	0
Agromyzidae	leaf-miner flies	2	80	0	0	0	0	0	0	0	0
Trixoscelididae	trixoscelidid flies	1	28	0	0	0	0	0	0	0	0
Anthomyiidae	anthomyiid flies	4	1228	3	44	5	112	5	228	4	228
Calliphoridae	blow flies	0	0	0	0	0	0	0	0	1	4
Tachinidae	tachinid flies	3	96	3	20	2	20	3	40	3	60
HYMENOPTERA											
Unknown		1	8	0	0	0	0	0	0	1	12
Argidae	argid sawflies	0	0	1	4	0	0	0	0	0	0
Braconidae	braconid wasps	7	96	5	20	1	8	9	68	6	64
Ichneumonidae	ichneumonid wasps	8	152	1	4	3	12	8	124	9	84
Mymaridae	fairyflies	1	4	0	0	1	4	0	0	0	0
Eulophidae	eulophid wasps	3	20	0	0	2	8	1	4	0	0
Encyrtidae	encyrtid wasps	2	12	0	0	1	8	3	12	0	0
Pteromalidae	pteromalid wasps	2	12	0	0	2	12	2	24	7	84
Chalcididae	chalcid wasps	0	0	0	0	1	4	0	0	0	0
Figitidae	figitid wasps	1	4	0	0	0	0	1	4	1	4
Proctotrupidae	prototrupid wasps	2	28	0	0	0	0	0	0	0	0
Ceraphronidae	ceraphronid wasps	1	4	0	0	0	0	0	0	0	0

Table 3-7-298 (continued)

ORDER / Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
Diapriidae	diapriid wasps	2	12	0	0	0	0	0	0	1	4
Scelionidae	scelionid wasps	1	4	0	0	0	0	1	4	0	0
Chrysididae	cuckoo wasps	0	0	0	0	1	20	1	8	0	0
Dryinidae	dryinid wasps	1	8	0	0	0	0	0	0	0	0
Tiphiidae	tiphiid wasps	0	0	1	40	1	32	1	20	0	0
Mutillidae	velvet ants	0	0	0	0	0	0	1	16	0	0
Formicidae	ants	3	92	0	0	0	0	3	36	5	36
Vespidae	paper wasps	1	4	0	0	0	0	1	4	0	0
Pompilidae	spider wasps	0	0	0	0	1	4	0	0	0	0
Sphecidae	sphecid wasps	7	80	2	8	9	64	2	12	7	32
Colletidae	yellow-faced bees	0	0	0	0	0	0	0	0	1	8
Halictidae	halictid bees	3	12	0	0	2	8	1	4	1	4
Megachilidae	leafcutting bees	0	0	0	0	4	16	3	12	0	0
Apidae	honey bees	0	0	0	0	1	4	1	4	1	8
TOTALS		88	4372	41	636	67	1020	80	2576	72	1592

Table 3-7-299. Numbers and percentages of invertebrates within each feeding type taken in Malaise trap samples at each site during July 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5 #	Site 5 %
Herbivores	608	13.9	84	13.2	20	2.0	624	24.2	8	0.5
Flower feeders	1596	36.5	324	50.9	608	59.6	1172	45.5	872	54.8
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	120	2.7	4	0.6	44	4.3	12	0.5	144	9.0
Omnivores	92	2.1	0	0.0	0	0.0	36	1.4	36	2.3
Predators	208	4.8	40	6.3	60	5.9	60	2.3	112	7.0
Unknown	1748	40.0	184	28.9	288	28.2	672	26.1	420	26.4

Table 3-7-300 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by Malaise trap sampling at all sites during September 1975 for RBOSP

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5 A	Site 5 B
ORTHOPTERA											
Acrididae	short-horned grasshoppers	1	4	0	0	0	0	0	0	0	0
HEMIPTERA											
Unknown		1	36	1	24	1	12	1	36	0	0
HOMOPTERA											
Unknown		0	0	1	76	1	84	1	116	0	0
Cicadellidae	leafhoppers	1	76	0	0	0	0	0	0	0	0
Aphididae	aphids	1	8	0	0	0	0	0	0	0	0
COLEOPTERA											
Cleridae	checkered beetles	0	0	0	0	0	0	1	4	0	0
Coccinellidae	ladybird beetles	0	0	1	4	0	0	0	0	0	0
Scarabaeidae	scarab beetles	1	8	1	48	1	8	1	8	1	8
NEUROPTERA											
Hemerobiidae	brown lacewings	0	0	0	0	1	4	1	24	0	0
LEPIDOPTERA											
Unknown		1	164	1	64	1	44	2	128	2	116
Hesperiidae	skippers	0	0	0	0	1	4	0	0	0	0
DIPTERA											
Psychodidae	moth flies-sand flies	1	4	0	0	0	0	0	0	0	0
Chironomidae	midges	2	36	1	8	2	12	3	32	2	104
Simuliidae	black flies	0	0	1	4	0	0	1	4	1	8
Bibionidae	march flies	0	0	0	0	0	0	0	0	1	4
Mycetophilidae	fungus gnats	0	0	0	0	0	0	0	0	1	4
Sciaridae	dark-winged fungus gnats	1	16	1	4	1	8	1	16	1	12
Cecidomyiidae	gall midges	1	48	0	0	1	56	1	60	1	56
Therevidae	stiletto flies	1	44	0	0	1	8	1	12	1	4
Asilidae	robber flies	0	0	2	8	1	4	0	0	2	20
Bombyliidae	bee flies	0	0	1	4	1	4	2	8	0	0
Empididae	dance flies	0	0	0	0	0	0	1	4	0	0
Dolichopodidae	long-legged flies	2	12	0	0	2	8	0	0	0	0
Phoridae	humpbacked flies	2	24	1	12	1	8	0	0	1	28
Pipunculidae	big-headed flies	1	28	1	12	1	8	1	8	0	0
Syrphidae	syrphid flies	2	16	0	0	0	0	1	4	1	4
Tephritidae	fruit flies	0	0	0	0	0	0	1	4	1	8

Table 3-7-300 (continued)

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5 A	 B
Sepsidae	black scavenger flies	0	0	0	0	0	0	1	8	0	0
Chamaemyiidae	aphid flies	1	12	0	0	0	0	0	0	0	0
Lonchaeidae	lonchaeid flies	0	0	0	0	0	0	0	0	1	24
Chloropidae	chloropid flies	6	132	2	16	3	20	4	64	2	64
Agromyzidae	leaf-miner flies	1	20	0	0	0	0	0	0	0	0
Anthomyiidae	anthomyiid flies	4	288	2	96	3	84	3	284	3	204
Calliphoridae	blow flies	1	4	0	0	0	0	0	0	0	0
Tachinidae	tachinid flies	2	8	2	16	5	32	4	36	4	40
HYMENOPTERA											
Braconidae	braconid wasps	5	52	1	8	3	20	4	20	5	68
Ichneumonidae	ichneumonid wasps	7	80	1	4	2	8	5	20	4	24
Eulophidae	eulophid wasps	1	4	0	0	1	4	1	4	0	0
Encyrtidae	encyrtid wasps	1	16	0	0	1	4	1	16	1	8
Pteromalidae	pteromalid wasps	1	4	1	4	3	12	3	12	1	4
Figitidae	figitid wasps	1	4	0	0	0	0	0	0	0	0
Cynipidae	gall wasps	1	4	0	0	0	0	1	8	0	0
Diapriidae	diapriid wasps	0	0	0	0	1	4	0	0	0	0
Platygasteridae	platygasterid wasps	1	4	0	0	0	0	0	0	0	0
Bethylidae	bethylid wasps	0	0	0	0	0	0	0	0	1	4
Tiphiidae	tiphiid wasps	0	0	1	4	1	4	0	0	0	0
Formicidae	ants	4	240	0	0	0	0	2	28	2	32
Pompilidae	spider wasps	0	0	0	0	1	4	0	0	0	0
Sphecidae	sphecid wasps	2	8	0	0	1	4	0	0	0	0
Colletidae	yellow-faced bees	2	8	0	0	0	0	0	0	0	0
Halictidae	halictid bees	2	8	0	0	1	4	0	0	2	8
Apidae	honey bees	0	0	1	8	0	0	0	0	0	0
	TOTALS	62	1420	24	424	43	476	49	968	42	856

Table 3-7-381. Numbers and percentages of invertebrates within each feeding type taken in Malaise trap samples at each site during September 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5 #	Site 5 %
Herbivores	132	9.3	0	0.0	92	19.3	128	13.2	4	0.5
Flower feeders	600	42.3	212	50.0	176	37.0	356	36.8	452	52.8
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	16	1.1	60	14.2	16	3.4	8	0.8	36	4.2
Omnivores	240	16.9	0	0.0	0	0.0	36	3.7	32	3.7
Predators	20	1.4	20	4.7	36	7.6	48	5.0	32	3.7
Unknown	412	29.0	132	31.1	156	32.8	392	40.5	300	35.0

Table 3-7-302. Results of trap d-vac invertebrate sampling from rabbitbrush (*Chrysothamnus nauseosus*), at site 1, greasewood-sagebrush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted #*	plant diameter(M)	plant volume(M3)	# of invertebrates per cubic meter
21	31	38.74	0.58	0.102160	379.2
22	23	28.74	0.46	0.050965	564.0
23	22	27.49	0.66	0.150533	182.6
24	15	18.74	0.33	0.018817	996.2
25	70	87.48	0.43	0.041630	2101.3

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-303. Average number of invertebrates collected from selected plant species by the trap d-vac method at each sampling site during June, 1975 for RBOSP

site	vegetation type	plant species	# of samples	avg. # of inverts. per cubic meter	variance	std. error
1	greasewood-sagebrush	*Chrysothamnus nauseosus*	5	844.6	583940.2	341.7
2	pinyon-juniper (south slope)	*Atriplex confertifolia*	5	277.7	50199.2	100.2
3	pinyon-juniper (north slope)	*Artemisia tridentata*	5	2809.4	22761698.2	2133.6
4	sagebrush	*Artemisia tridentata*	5	235.8	10742.6	46.4
5A	mixed brush	*Amelanchier utahensis*	5	733.9	967806.4	440.0
5B	mixed brush	*Symphoricarpos oreophilus*	5	732.3	316603.4	251.6

Table 3-7- 304. Results of Trap D-vac sampling of plant species at each site during June, 1975 for RBOSP

ORDER Family	Common Name	Site 1 *Chrysothamnus nauseosus* A*	Site 1 B**	Site 2 *Atriplex confertifolia* A	Site 2 B	Site 3 *Artemisia tridentata* A	Site 3 B	Site 4 *Artemisia tridentata* A	Site 4 B	Site 5A *Amelanchier utahensis* A	Site 5A B	Site 5B *Symphoricarpos oreophilus* A	Site 5B B
ORTHOPTERA													
Gryllacrididae	longhorned grasshoppers									1	1		
THYSANOPTERA	thrips	3	50	1	3			2	3	1	1	1	4
HEMIPTERA													
Miridae nymph	plant bugs			1	1			1	2				
Tingidae	lace bugs			1	1			1	1			1	1
Tingidae nymph	lace bugs	1	3										
Aradidae	flat bugs									1	1		
Lygaeidae	seed bugs							1	1	1	1	1	1
Unknown nymph		1	3					1	5			1	2
HOMOPTERA													
Cicadellidae	leafhoppers	3	3	1	4			2	3				
Cicadellidae nymph	leafhoppers	2	30	3	4	1	1	2	2			2	5
Delphacidae	delphacid planthoppers	1	10					3	6				
Psyllidae	psyllids							1	1	1	1		
Aphididae	aphids	1	6									1	1
Coccoidea (superfamily)	scale insects	1	5	1	8					1	2	1	1
Unknown nymphs		1	4					1	1				
COLEOPTERA													
Ostomidae	bark-gnawing beetles					1	1						
Cleridae	checkered beetles									1	2		
Elateridae	click beetles			1	2	2	2	1	1	1	1		

Table 3-7- 304. (Continued)

ORDER Family	Common Name	Site 1 Chrysothamnus nauseosus A*	B**	Site 2 Atriplex conferitolia A	B	Site 3 Artemisia tridentata A	B	Site 4 Artemisia tridentata A	B	Site 5A Amelanchier utahensis A	B	Site 5B Symphoricarpos oreophilus A	B
COLEOPTERA (Cont.)													
Coccinellidae	ladybird beetles							2	6	1	1		
Anthicidae	antlike flower beetles	1	35										
Meloidae	blister beetles											1	1
Scrabaeidae	scarab beetles							1	1				
Chrysomelidae	leaf beetles	1	1					1	1				
Curculionidae	snout beetles	2	16	1	2	1	10	1	2	1	6	4	8
LEPIDOPTERA													
Arctiidae larvae	tiger moths	1	1										
Noctuidae	armyworms, cutworms											1	1
Noctuidae larvae	armyworms, cutworms					1	1	2	6	1	5	1	2
Geometridae	geometer moths									1	1		
Superfamily Pyralidoidea larvae								1	2				
Pterophoridae larvae	plume moths					1	1						
Superfamily Tortricoidea larvae				1	15	1	2						
Unknown larvae		1	1	1	1	1	1	1	6				
DIPTERA													
Chironomidae	non-biting midges					1	1						
Cecidomyiidae	gall midges					1	1					1	2
Therevidae larvae	stiletto flies					1	1			1	1	1	4
Phoridae	humpbacked flies	1	2										
HYMENOPTERA													
Braconidae	braconid wasps	1	1	1	1							2	2
Ichneumonidae	ichneumonid wasps							1	1				
Eulophidae	eulophid wasps	2	2	1	1								
Pteromalidae	pteromalid wasps	1	1									1	1

Table 3-7-304. (Continued)

ORDER Family	Common Name	Site 1 Chrysothamnus nauseosus A*	 B**	Site 2 Atriplex confertifolia A	 B	Site 3 Artemisia tridentata A	 B	Site 4 Artemisia tridentata A	 B	Site 5A Amelanchier utahnesis A	 B	Site 5B Symphoricarpos oreophilus A	 B
HYMENOPTERA (cont.)													
Ceraphronidae	ceraphronid wasps											1	1
Diapriidae	diapriid wasps	2	2	1	1			1	1				
Platygasteridae	platygasterid wasps	3	6										
Dryinidae	dryinid wasps							1	1				
Unknown		1	1										
PHALANGIDA	harvestmen	1	1										
TOTAL		32	184	14	43	12	22	26	53	13	24	21	37

* A = Number of species groups

** B = Total number of individuals

Table 3-7-305. Percentages of invertebrates within each feeding type taken in Trap D-vac samples at each site during June, 1975 for RBOSP

	Site 1	Site 2	Site 3	Site 4	Site 5A	Site 5B
Herbivores	91.0	93.0	81.8	83.0	87.5	70.3
Flower feeders	-	-	4.6	-	4.2	2.7
Fungus feeders	-	-	4.6	-	-	5.0
Saprovores	2.0	-	-	-	-	-
Omnivores	-	-	-	-	-	-
Predators	6.5	7.0	9.0	17.0	8.3	22.0
Unknown	1.0	-	-	-	-	-

Table 3-7- 306 Results of trap d-vac invertebrate sampling from rabbitbrush (<u>Chrysothamnus</u> <u>nauseosus</u>) at site 1, greasewood-sagebrush, during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted # *	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
213	26	26.00	0.66	0.150533	172.7
214	16	16.00	0.23	0.006288	2544.6
215	4	4.00	0.23	0.006288	636.1
216	11	11.00	0.33	0.018817	584.6
217	50	50.00	0.43	0.042213	1184.5

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-307 Average number of invertebrates collected from selected plant species by the trap d-vac method at each sampling site during July 1975 for RBOSP

Site	Vegetation type	Plant species	# of Samples	Avg. # of inverts. per cubic meter	Variance	Std. error
1	greasewood-sagebrush	*Chrysothamnus nauseosus*	5	1024.5	851519.7	412.7
2	pinyon-juniper (south slope)	*Atriplex confertifolia*	5	709.2	710923.2	377.1
3	pinyon-juniper (north slope)	*Artemesia tridentata*	5	106.9	3432.9	26.2
4	sagebrush	*Artemesia tridentata*	5	299.0	209668.2	204.8
5A	mixed brush	*Amelanchier utahensis*	5	133.9	19093.5	61.8
5B	mixed brush	*Symphoricarpos oreophilus*	5	344.9	210026.2	205.0

Table 3-7-308 Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by trap D-vac sampling at all sites during July 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5A A	 B	Site 5B A	 B
COLLEMBOLA													
Sminthuridae	globular springtails	0	0	0	0	2	4	0	0	0	0	0	0
ORTHOPTERA													
Acrididae	short-horned grasshoppers	0	0	1	1	0	0	0	0	0	0	1	1
THYSANOPTERA													
Unknown		5	37	1	1	0	0	1	4	1	1	1	1
HEMIPTERA													
Miridae	plant bugs	1	1	1	1	0	0	0	0	1	2	0	0
Cydnidae	burrower bugs	0	0	1	3	0	0	0	0	0	0	0	0
HOMOPTERA													
Unknown		1	1	1	1	0	0	1	3	0	0	0	0
Cicadellidae	leafhoppers	4	11	3	14	0	0	5	7	3	3	1	1
Cercopidae	froghoppers	1	1	0	0	0	0	0	0	0	0	0	0
Aphididae	aphids	1	1	0	0	1	1	0	0	1	1	1	1
COLEOPTERA													
Ostomidae	bark-gnawing beetles	0	0	0	0	0	0	1	1	0	0	0	0
Cleridae	checkered beetles	1	1	1	3	1	1	0	0	0	0	1	1
Coccinellidae	ladybird beetles	1	1	0	0	1	1	2	4	0	0	0	0
Anthicidae	antlike flower beetles	1	15	0	0	0	0	0	0	0	0	0	0
Melandryidae	false darkling beetles	1	7	0	0	0	0	0	0	0	0	0	0
Anobiidae	anobiid beetles	0	0	1	1	0	0	0	0	1	1	0	0
Chrysomelidae	leaf beetles	0	0	1	1	1	1	0	0	0	0	0	0
Curculionidae	snout beetles	2	20	1	1	2	3	2	6	1	1	1	3
LEPIDOPTERA													
Unknown		0	0	2	3	0	0	0	0	0	0	0	0
Noctuidae	cutworm moths	1	2	0	0	0	0	0	0	1	1	1	1
Coleophoridae	casebearers	1	1	0	0	0	0	0	0	0	0	0	0
DIPTERA													
Psychodidae	moth flies-sand flies	0	0	0	0	0	0	0	0	1	1	0	0
Culicidae	mosquitoes	0	0	1	2	0	0	0	0	0	0	0	0
Chironomidae	midges	0	0	3	22	0	0	1	1	1	1	1	3
Cecidomyiidae	gall midges	0	0	0	0	0	0	0	0	1	1	0	0
Sphaeroceridae	small dung flies	1	2	0	0	0	0	0	0	0	0	0	0
Anthomyiidae	anthomyiid flies	0	0	1	2	0	0	0	0	0	0	0	0

Table 3-7-308 (continued)

ORDER Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5A A	Site 5A B	Site 5B A	Site 5B B
HYMENOPTERA													
Diprionidae	conifer sawflies	0	0	0	0	0	0	0	0	0	0	1	1
Braconidae	braconid wasps	0	0	1	1	1	1	0	0	0	0	0	0
Cynipidae	gall wasps	1	1	0	0	0	0	0	0	0	0	0	0
Platygasteridae	platygasterid wasps	1	2	0	0	1	4	0	0	0	0	0	0
Bethylidae	bethylid wasps	0	0	1	3	0	0	0	0	0	0	0	0
Diapriidae	diapriid wasps	1	3	0	0	0	0	0	0	0	0	0	0
	TOTALS	25	107	21	60	10	16	13	26	12	13	9	13

Table 3-7-309. Numbers and percentages of invertebrates within each feeding type taken in trap D-vac samples at each site during July 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5A #	Site 5A %	Site 5B #	Site 5B %
Herbivores	82	76.6	24	40.0	9	56.3	20	76.9	10	76.9	9	69.2
Flower feeders	3	2.8	29	48.3	5	31.3	1	3.8	1	7.7	3	23.1
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Omnivores	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Predators	5	4.7	5	8.3	2	12.5	5	19.2	1	7.7	1	7.7
Unknown	17	15.9	2	3.3	0	0.0	0	0.0	1	7.7	0	0.0

Table 3-7-310. Results of trap d-vac invertebrate sampling from rabbitbrush (*Chrysothamnus nauseosus*) at site 1, greasewood-sagebrush, during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
303	23	56.00	0.25	0.008580	6526.6
304	9	21.91	0.31	0.014856	1475.0
305	34	82.78	0.61	0.118847	696.5
306	23	56.00	0.66	0.150533	372.0
307	17	41.39	0.46	0.049974	828.3

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-311. Average number of invertebrates collected from selected plant species by the trap d-vac method at each sampling site during September 1975 for RBOSP

Site	Vegetation type	Plant species	# of Samples	Avg. # of inverts. per cubic meter	Variance	Std. error
1	greasewood-sagebrush	Chrysothamnus nauseosus	5	1979.7	6621531.0	1150.8
2	pinyon-juniper (south slope)	Atriplex confertifolia	5	2035.8	6579342.3	1147.1
3	pinyon-juniper (north slope)	Artemesia tridentata	5	12899.7	238060772.4	6900.2
4	sagebrush	Artemesia tridentata	5	6931.7	120719484.2	4913.6
5A	mixed brush	Amelanchier utahensis	5	2698.4	10768185.1	1467.5
5B	mixed brush	Symphoricarpos oreophilus	5	2118.6	3540595.4	841.5

Table 3-7-312. Number of species groups (A) and total number of individuals (B) for invertebrate taxa collected by trap D-vac sampling at all sites during September 1975 for RBOSP

ORDER Family	Common name	Site 1 A	 B	Site 2 A	 B	Site 3 A	 B	Site 4 A	 B	Site 5A A	 B	Site 5B A	 B
COLLEMBOLA													
Sminthuridae	globular springtails	1	1	1	2	0	0	0	0	1	4	1	25
ORTHOPTERA													
Acrididae	short-horned grasshoppers	0	0	0	0	0	0	0	0	0	0	1	0
THYSANOPTERA													
Unknown		4	51	1	3	0	0	1	1	2	7	3	17
HEMIPTERA													
Miridae	plant bugs	1	1	0	0	0	0	0	0	2	8	1	1
Nabidae	damsel bugs	0	0	0	0	0	0	0	0	1	1	0	0
Reduviidae	assassin bugs	0	0	0	0	0	0	0	0	1	1	0	0
Piesmatidae	ash-grey leaf bugs	0	0	0	0	0	0	0	0	0	0	1	2
Lygaeidae	seed bugs	1	1	0	0	0	0	0	0	0	0	1	1
HOMOPTERA													
Unknown		1	2	1	7	1	11	0	0	2	8	1	4
Cicadellidae	leafhoppers	8	14	3	4	1	1	3	5	8	12	3	5
Delphacidae	delphacid planthoppers	1	2	0	0	0	0	0	0	1	5	1	2
Aphididae	aphids	0	0	0	0	1	1	1	1	1	8	1	8
COLEOPTERA													
Ostomidae	bark-gnawing beetles	0	0	0	0	0	0	1	1	0	0	0	0
Cleridae	checkered beetles	1	7	1	1	0	0	0	0	1	1	0	0
Coccinellidae	ladybird beetles	0	0	0	0	1	2	0	0	0	0	0	0
Anthicidae	antlike flower beetles	1	1	0	0	0	0	0	0	1	1	1	3
Melandryidae	false darkling beetles	0	0	0	0	0	0	1	1	0	0	0	0
Chrysomelidae	leaf beetles	1	1	2	5	0	0	0	0	1	1	1	1
Curculionidae	snout beetles	2	20	2	2	1	8	2	2	2	2	4	8
NEUROPTERA													
Chrysopidae	green lacewings	0	0	0	0	0	0	0	0	0	0	1	1
LEPIDOPTERA													
Unknown		0	0	0	0	0	0	1	1	3	6	0	0
Gracilariidae	leaf blotch miners	1	1	0	0	0	0	0	0	0	0	0	0
DIPTERA													
Mycetophilidae	fungus gnats	0	0	0	0	0	0	0	0	1	1	0	0
Therevidae	stiletto flies	0	0	0	0	1	5	0	0	0	0	0	0
Phoridae	humpbacked flies	0	0	0	0	0	0	0	0	0	0	1	2

Table 3-7-312. (continued)

ORDER / Family	Common name	Site 1 A	Site 1 B	Site 2 A	Site 2 B	Site 3 A	Site 3 B	Site 4 A	Site 4 B	Site 5A A	Site 5A B	Site 5B A	Site 5B B
Chloropidae	chloropid flies	0	0	0	0	0	0	0	0	0	0	1	1
Anthomyiidae	anthomyiid flies	1	1	0	0	0	0	0	0	0	0	0	0
HYMENOPTERA													
Unknown		0	0	0	0	0	0	1	2	0	0	0	0
Braconidae	braconid wasps	0	0	0	0	0	0	0	0	1	1	3	2
Eulophidae	eulophid wasps	0	0	1	0	0	0	0	0	0	0	4	4
Pteromalidae	pteromalid wasps	0	0	0	0	0	0	0	0	1	1	0	0
Cynipidae	gall wasps	0	0	0	0	0	0	0	0	1	1	0	0
Ceraphronidae	ceraphronid wasps	0	0	0	0	0	0	0	0	0	0	2	3
Diapriidae	diapriid wasps	2	3	0	0	0	0	0	0	0	0	0	0
Platygasteridae	platygasterid wasps	0	0	0	0	0	0	0	0	1	1	0	0
TOTALS		26	106	12	24	6	28	11	14	32	70	32	90

Table 3-7-313. Numbers and percentages of invertebrates within each feeding type taken in trap D-vac samples at each site during September 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2 #	Site 2 %	Site 3 #	Site 3 %	Site 4 #	Site 4 %	Site 5A #	Site 5A %	Site 5B #	Site 5B %
Herbivores	93	87.7	21	87.5	21	75.0	11	78.6	54	77.1	49	54.4
Flower feeders	3	2.8	0	0.0	0	0.0	1	7.1	7	10.0	10	11.1
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	1	0.9	2	8.3	0	0.0	0	0.0	4	5.7	27	30.0
Omnivores	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Predators	7	6.6	1	4.2	7	25.0	0	0.0	4	5.7	1	1.1
Unknown	2	1.9	0	0.0	0	0.0	2	14.3	1	1.4	3	3.3

Table 3-7-314. Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 2, pinyon-juniper (south slope), during June, 1975 for RBOSP

taxon	# collected	relative abundance**	density (#/M2)
THYSANURA	7	0.41	0.25
COLLEMBOLA	1525	89.13	22.92
COLEOPTERA	14	0.82	0.18
LEPIDOPTERA	2	0.12	***
HYMENOPTERA	39	2.28	2.83
SCORPIONIDA	2	0.12	0.02
CHELONETHIDA	1	0.06	0.01
ARANEIDA	20	1.17	***
ACARI	101	5.90	***

* catch-effort regression method (Gist and Crossley, Jr.,1973)
** (# collected each taxon, site 2/# collected all taxa, site 2) X 100
*** assumptions of density estimation method not met

Table 3-7-315 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 2, pinyon-juniper (south slope), during July 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
THYSANURA	14	1.53	***
COLLEMBOLA	22	2.41	***
ORTHOPTERA	6	0.66	0.23
COLEOPTERA	25	2.74	0.32
HYMENOPTERA	85	9.31	1.35
SCORPIONIDA	1	0.11	0.01
SOLPUGIDA	1	0.11	0.01
ARANEIDA	22	2.41	***
ACARI	737	80.72	6.49

* catch-effort regression method (Gist and Crossley, Jr.,1973)
** (# collected each taxon, site 2/# collected all taxa, site 2) X 100
*** assumptions of density estimation method not met

Table 3-7-316 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 2, pinyon-juniper (south slope), during September 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
THYSANURA	5	2.28	***
COLLEMBOLA	6	2.74	0.07
ORTHOPTERA	1	0.46	0.01
HEMIPTERA	9	4.11	0.13
COLEOPTERA	13	5.94	0.14
DIPTERA	23	10.50	0.31
HYMENOPTERA	90	41.10	1.29
ARANEIDA	72	32.88	0.95

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 2/# collected all taxa, site 2) X 100
*** assumptions of density estimation method not met

Table 3-7-317. Results of litter d-vac invertebrate sampling at site 2, pinyon-juniper (south slope), during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted # *	litter dry weight (gm)	# of invertebrates per kilogram litter
127	0	0.00	499.00	0.0
128	0	0.00	398.00	0.0
129	1	1.00	486.00	2.1
130	1	1.00	388.00	2.6
131	1	1.00	236.00	4.2

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-318 Results of litter d-vac invertebrate sampling at site 2, pinyon-juniper (south slope), during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted # *	litter dry weight (gm)	# of invertebrates per kilogram litter
127	0	0.00	499.00	0.0
128	0	0.00	398.00	0.0
129	1	1.00	486.00	2.1
130	1	1.00	388.00	2.6
131	1	1.00	236.00	4.2

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-319 Results of litter d-vac invertebrate sampling at site 2, pinyon-juniper (south slope), during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Litter dry Weight (gm)	# of invertebrates per kilogram litter
390	14	14.80	576.00	25.7
391	9	9.51	870.00	10.9
392	35	37.00	382.00	96.9
393	34	35.94	424.00	84.8
394	15	15.86	937.00	16.9

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-320. Numbers and percentages of invertebrates within each feeding type taken in beating samples at each site during September 1975 for RBOSP

Feeding type	Site 1 #	Site 1 %	Site 2P #	Site 2P %	Site 2J #	Site 2J %	Site 3P #	Site 3P %	Site 3J #	Site 3J %
Herbivores	142	82.1	70	76.1	9	56.3	5	18.5	3	9.7
Flower feeders	3	1.7	2	2.2	0	0.0	0	0.0	3	9.7
Fungus feeders	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Saprovores	0	0.0	1	1.1	0	0.0	0	0.0	16	51.6
Omnivores	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Predators	6	3.5	18	19.6	4	25.0	22	81.5	8	25.8
Unknown	22	12.7	1	1.1	3	18.8	0	0.0	1	3.2

Table 3-7-321. Results of trap d-vac invertebrate sampling from shadscale (<u>Atriplex confertifolia</u>), at site 2, pinyon-juniper (south slope), during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted # *	plant diameter (M)	plant volume (M3)	# of invertebrates per cubic meter
36	5	5.00	0.25	0.008181	611.2
37	9	9.00	0.36	0.024429	368.4
38	8	8.00	0.61	0.118847	67.3
39	6	6.00	0.51	0.069456	86.4
40	13	13.00	0.46	0.050965	255.1

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-322 Results of trap d-vac invertebrate sampling from shadscale (_Atriplex confertifolia_) at site 2, pinyon-juniper (south slope), during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
228	20	20.00	0.51	0.068642	291.4
229	19	19.00	0.25	0.008580	2214.4
230	8	8.00	0.33	0.018817	425.2
231	7	7.00	0.36	0.023624	296.3
232	6	6.00	0.33	0.018817	318.9

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-323. Results of trap d-vac invertebrate sampling from shadscale (<u>Atriplex confertifolia</u>) at site 2, pinyon-juniper (south slope), during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
407	6	14.36	0.41	0.035041	409.7
408	7	16.75	0.20	0.004380	3824.1
409	4	9.57	0.41	0.035041	273.1
410	7	16.75	0.18	0.002953	5672.3
411	0	0.00	0.25	0.008580	0.0

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-324 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 3, pinyon-juniper (north slope), during June, 1975 for RBOSP

taxon	# collected	relative abundance**	density (#/M2)
COLLEMBOLA	240	62.02	***
COLEOPTERA	59	15.25	***
LEPIDOPTERA	1	0.26	0.01
HYMENOPTERA	39	10.08	***
CHELONETHIDA	1	0.26	0.01
SOLPUGIDA	1	0.26	0.01
ARANEIDA	16	4.13	0.57
ACARI	30	7.75	***

* catch-effort regression method (Gist and Crossley, Jr.,1973)
** (# collected each taxon, site 3/# collected all taxa, site 3) X 100
*** assumptions of density estimation method not met

Table 3-7-325 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 3, pinyon-juniper (north slope), during July 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
COLLEMBOLA	400	33.28	***
ORTHOPTERA	4	0.33	0.06
PSOCOPTERA	1	0.08	0.01
COLEOPTERA	71	5.91	***
LEPIDOPTERA	2	0.17	0.02
HYMENOPTERA	91	7.57	***
ARANEIDA	32	2.66	***
PHALANGIDA	1	0.08	0.01
ACARI	600	49.92	5.14

* catch-effort regression method (Gist and Crossley, Jr.,1973)
** (# collected each taxon, site 3/# collected all taxa, site 3) X 100
*** assumptions of density estimation method not met

Table 3-7-326 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 3, pinyon-juniper (north slope), during September 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
COLLEMBOLA	12	2.82	***
ORTHOPTERA	1	0.24	0.01
COLEOPTERA	33	7.76	0.73
LEPIDOPTERA	1	0.24	0.01
HYMENOPTERA	17	4.00	0.46
ARANEIDA	19	4.47	0.59
PHALANGIDA	1	0.24	0.01
ACARI	340	80.00	12.83
GEOPHILOMORPHA	1	0.24	0.01

* catch-effort regression method (Gist and Crossley, Jr.,1973)
** (# collected each taxon, site 3/# collected all taxa, site 3) X 100
*** assumptions of density estimation method not met

Table 3-7-327. Results of litter d-vac invertebrate sampling at site 3, pinyon-juniper (north slope), during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted # *	litter dry weight (gm)	# of invertebrates per kilogram litter
122	10	10.00	688.00	14.5
123	0	0.00	554.00	0.0
124	0	0.00	421.00	0.0
125	1	1.00	326.00	3.1
126	2	2.00	274.00	7.3

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-328 Results of litter d-vac invertebrate sampling at site 3, pinyon-juniper (north slope), during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted # *	Litter dry Weight (gm)	# of invertebrates per kilogram litter
258	72	72.00	890.00	80.9
259	66	66.00	900.00	73.3
260	19	19.00	930.00	20.4
261	45	45.00	910.00	49.5
262	36	36.00	436.00	82.6

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-329 Results of litter d-vac invertebrate sampling at site 3, pinyon-juniper (north slope), during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Litter dry Weight (gm)	# of invertebrates per kilogram litter
336	92	95.00	987.00	96.3
337	4	4.13	1069.00	3.9
338	8	8.26	1041.00	7.9
339	3	3.10	730.00	4.2
340	87	89.84	808.00	111.2

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-330. Results of trap d-vac invertebrate sampling from sagebrush (*Artemisia tridentata*), at site 3, pinyon-juniper (north slope), during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted #*	plant diameter (M)	plant volume (M3)	# of invertebrates per cubic meter
49	2	4.00	0.51	0.069456	57.6
50	8	16.00	0.15	0.001767	9054.1
51	2	4.00	0.23	0.006371	627.9
52	2	4.00	0.23	0.006371	627.9
53	5	10.00	0.28	0.011494	870.0

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-331 Results of trap d-vac invertebrate sampling from sagebrush (<u>Artemesia</u> <u>tridentata</u>) at site 3, pinyon-juniper (north slope), during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
248	7	7.00	0.51	0.068642	102.0
249	2	2.00	0.36	0.023624	84.7
250	1	1.00	0.36	0.023624	42.3
251	3	3.00	0.31	0.014856	201.9
252	3	3.00	0.38	0.028958	103.6

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-332. Results of trap d-vac invertebrate sampling from sagebrush (<u>Artemesia tridentata</u>) at site 3, pinyon-juniper (north slope), during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
318	1	69.00	0.25	0.008580	8041.7
319	2	138.00	0.41	0.035041	3938.2
320	3	207.00	0.43	0.042213	4903.7
321	11	759.00	0.58	0.104289	7277.9
322	11	759.00	0.33	0.018817	40336.8

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-333. Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 4, sagebrush, during June, 1975 for RBOSP

taxon	# collected	relative abundance**	density* (#/M2)
COLLEMBOLA	4856	91.40	80.27
ORTHOPTERA	2	0.04	***
COLEOPTERA	23	0.43	0.31
LEPIDOPTERA	13	0.24	***
HYMENOPTERA	248	4.67	***
ARANEIDA	50	0.94	0.90
ACARI	121	2.28	***

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 4/# collected all taxa, site 4) X 100
*** assumptions of density estimation method not met

3-7-852

Table 3-7-334 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 4, sagebrush, during July 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
THYSANURA	2	0.06	0.03
COLLEMBOLA	2658	77.52	27.38
ORTHOPTERA	18	0.52	0.58
COLEOPTERA	23	0.67	0.27
LEPIDOPTERA	6	0.17	0.05
HYMENOPTERA	504	14.70	16.82
SOLPUGIDA	3	0.09	0.04
ARANEIDA	47	1.37	0.72
ACARI	167	4.87	2.34
GEOPHILOMORPHA	1	0.03	0.01

* catch-effort regression method (Gist and Crossley, Jr.,1973)
** (# collected each taxon, site 4/# collected all taxa, site 4) X 100

Table 3-7-335 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 4, sagebrush, during September 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
COLLEMBOLA	1	0.24	0.01
ORTHOPTERA	34	8.06	***
COLEOPTERA	13	3.08	0.21
LEPIDOPTERA	5	1.18	0.07
HYMENOPTERA	119	28.20	5.06
SOLPUGIDA	3	0.71	***
ARANEIDA	43	10.19	2.44
ACARI	203	48.10	10.78
GEOPHILOMORPHA	1	0.24	0.01

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 4/# collected all taxa, site 4) X 100
*** assumptions of density estimation method not met

Table 3-7-336. Results of litter d-vac invertebrate sampling at site 4, sagebrush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted * #	litter dry weight (gm)	# of invertebrates per kilogram litter
87	45	45.00	131.00	343.5
88	11	11.00	215.00	51.2
89	128	128.00	173.00	739.9
90	177	177.00	124.00	1427.4
157	11	11.00	314.00	35.0

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-336 Results of litter d-vac invertebrate sampling at site 4, sagebrush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted #*	litter dry weight (gm)	# of invertebrates per kilogram litter
87	45	45.00	131.00	343.5
88	11	11.00	215.00	51.2
89	128	128.00	173.00	739.9
90	177	177.00	124.00	1427.4
157	11	11.00	314.00	35.0

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-338. Results of litter d-vac invertebrate sampling at site 4, sagebrush, during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Litter dry Weight (gm)	# of invertebrates per kilogram litter
375	27	35.00	139.00	251.8
376	1	1.30	162.00	8.0
377	12	15.56	225.00	69.1
378	12	15.56	215.00	72.4
379	7	9.07	170.00	53.4

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-339. Results of trap d-vac invertebrate sampling from sagebrush (*Artemisia tridentata*), at site 4, sagebrush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted # *	plant diameter (M)	plant volume (M3)	# of invertebrates per cubic meter
11	13	17.00	0.46	0.050965	333.6
12	7	9.15	0.43	0.041630	219.9
13	8	10.46	0.43	0.041630	251.3
14	5	6.54	0.53	0.077952	83.9
15	8	10.46	0.38	0.028731	364.1

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-340. Results of trap d-vac invertebrate sampling from sagebrush (*Artemesia tridentata*) at site 4, sagebrush, during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
163	8	8.00	0.46	0.049971	160.1
164	1	1.00	0.36	0.023624	42.3
165	7	7.00	0.64	0.134066	52.2
166	7	7.00	0.23	0.006288	1113.3
167	3	3.00	0.36	0.023624	127.0

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-341. Results of trap d-vac invertebrate sampling from sagebrush (*Artemesia tridentata*) at site 4, sagebrush, during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted # *	Plant Diameter (M)	Plant Volume (M3)	# of invertebrates per cubic meter
370	6	174.00	0.51	0.068642	2534.9
371	1	29.00	0.31	0.014856	1952.1
372	2	58.00	0.71	0.188195	308.2
373	4	116.00	0.20	0.004380	26483.2
374	1	29.00	0.25	0.008580	3379.9

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-342 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 5, mixed brush, during June, 1975 for RBOSP

taxon	# collected	relative abundance**	density (#/M2)
THYSANURA	28	10.85	0.42
COLLEMBOLA	32	12.40	0.40
ORTHOPTERA	5	1.94	0.04
COLEOPTERA	29	11.24	***
LEPIDOPTERA	8	3.10	0.19
HYMENOPTERA	77	29.84	1.33
ARANEIDA	45	17.44	0.96
PHALANGIDA	13	5.04	0.65
ACARI	21	8.14	***

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 5/# collected all taxa, site 5) X 100
*** assumptions of density estimation method not met

Table 3-7-343 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 5, mixed brush, during July 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
THYSANURA	185	26.24	2.33
COLLEMBOLA	28	3.97	***
ORTHOPTERA	13	1.84	***
PSOCOPTERA	1	0.14	0.01
COLEOPTERA	86	12.20	1.19
LEPIDOPTERA	6	0.85	0.09
HYMENOPTERA	230	32.62	***
CHILOMENTHIDA	1	0.14	0.01
ARANEIDA	47	6.67	***
PHALANGIDA	7	0.99	***
ACARI	101	14.33	***

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 5/# collected all taxa, site 5) X 100
*** assumptions of density estimation method not met

Table 3-7-344 Relative abundance and population density estimates* for ground dwelling invertebrates collected by pitfall traps at site 5, mixed brush, during September 1975 for RBOSP

Taxon	# collected	Relative abundance**	Density (#/M2)
THYSANURA	25	11.11	0.54
COLLEMBOLA	13	5.78	0.29
ORTHOPTERA	9	4.00	0.11
COLEOPTERA	18	8.00	0.32
LEPIDOPTERA	1	0.44	0.01
HYMENOPTERA	34	15.11	0.89
CHELONETHIDA	2	0.89	0.05
ARANEIDA	57	25.33	2.40
PHALANGIDA	1	0.44	0.01
ACARI	65	28.89	***

* catch-effort regression method (Gist and Crossley, Jr., 1973)
** (# collected each taxon, site 5/# collected all taxa, site 5) X 100
*** assumptions of density estimation method not met

Table 3-7-345. Results of litter d-vac invertebrate sampling at site 5, mixed brush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted # *	litter dry weight (gm)	# of invertebrates per kilogram litter
76	42	42.00	342.00	122.8
77	11	11.00	423.00	26.0
80	9	9.00	254.00	35.4
155	77	77.00	292.00	263.7
156	60	60.00	322.00	186.3

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-346 Results of litter d-vac invertebrate sampling at site 5, mixed brush, during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted # *	Litter dry Weight (gm)	# of invertebrates per kilogram litter
178	27	27.00	456.00	59.2
179	27	27.00	525.00	51.4
180	124	124.00	543.00	228.4
181	111	111.00	941.00	118.0
182	76	76.00	1255.00	60.6

* # of invertebrates in sample X Berlese calibration factor

3-7-864

Table 3-7-347 Results of litter d-vac invertebrate sampling at site 5, mixed brush, during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Litter dry Weight (gm)	# of invertebrates per kilogram litter
365	51	51.00	103.00	495.1
366	332	332.00	197.00	1685.3
367	61	61.00	192.00	317.7
368	156	156.00	182.00	857.1
369	30	30.00	356.00	84.3

* # of invertebrates in sample X Berlese calibration factor

Table 3-7-348. Results of trap d-vac invertebrate sampling from serviceberry (*Amelanchier utahensis*), at site 5A, mixed brush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted # *	plant diameter (M)	plant volume (M3)	# of invertebrates per cubic meter
54	4	4.00	0.43	0.041630	96.1
55	4	4.00	0.51	0.069456	57.6
56	6	6.00	0.58	0.102160	58.7
57	5	5.00	0.20	0.004189	1193.7
58	4	4.00	0.15	0.001767	2263.5

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-349 Results of trap d-vac invertebrate sampling from serviceberry (Amelanchier utahensis) at site 5A, mixed brush, during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter (M)	Plant Volume (M3)	# of invertebrates per cubic meter
173	4	4.00	0.33	0.018817	212.6
174	0	0.00	0.41	0.035041	0.0
175	2	2.00	0.69	0.169033	11.8
176	2	2.00	0.23	0.006125	326.6
177	5	5.00	0.43	0.042213	118.4

* # of invertebrates in sample X d-vac and Berlese calibration factors

3-7-867

Table 3-7-350. Results of trap d-vac invertebrate sampling from serviceberry (Amelanchier utahensis) at site 5A, mixed brush, during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
308	6	12.00	0.23	0.006288	1908.4
309	2	4.00	0.28	0.011371	351.8
310	16	32.00	0.61	0.118847	269.3
311	20	40.00	0.31	0.014856	2692.5
312	26	52.00	0.23	0.006288	8269.9

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-351. Results of trap d-vac invertebrate sampling from snowberry (<u>Symphoricarpos oreophilus</u>), at site 5B, mixed brush, during June, 1975 for RBOSP

sample #	# of invertebrates in sample	adjusted #*	plant diameter (M)	plant volume (M3)	# of invertebrates per cubic meter
66	11	11.00	0.51	0.069456	158.4
67	2	2.00	0.15	0.001767	1131.8
68	9	9.00	0.23	0.006371	1412.7
69	5	5.00	0.23	0.006371	784.9
70	2	2.00	0.28	0.011494	174.0

* # of invertebrates in sample X d-vac and Berlese calibration factors

Table 3-7-352. Results of trap d-vac invertebrate sampling from snowberry (*Symphoricarpos oreophilus*) at site 5?, mixed brush, during July 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
168	5	5.00	0.20	0.004380	1141.5
169	3	3.00	0.41	0.035041	85.6
170	4	4.00	0.31	0.014856	269.3
171	1	1.00	0.20	0.004380	228.3
172	0	0.00	0.31	0.014856	0.0

* # of invertebrates in sample X d-vac and Berlese calibration factors

3-7-870

Table 3-7-353. Results of trap d-vac invertebrate sampling from snowberry (<u>Symphoricarpos</u> <u>oreophilus</u>) at site 5B, mixed brush, during September 1975 for RBOSP

Sample #	# of invertebrates in sample	Adjusted #*	Plant Diameter(M)	Plant Volume(M3)	# of invertebrates per cubic meter
313	6	9.00	0.20	0.004380	2054.7
314	22	33.00	0.23	0.006288	5248.2
315	21	31.50	0.33	0.018817	1674.1
316	33	49.50	0.41	0.035041	1412.6
317	8	12.00	0.48	0.058998	203.4

* # of invertebrates in sample X d-vac and Berlese calibration factors

H. Domestic Livestock

1. Objectives - Numbers of livestock on the study area are being determined and areas of concentration are being estimated on a seasonal basis to help define the extent and type of grazing pressure exerted by domestic herbivores.

2. Methods

a. Aerial Censuses - Aerial censuses are being used to determine the locations of domestic livestock within the area of investigation. The domestic livestock censuses are conducted bimonthly in conjunction with the large mammal aerial censuses. Since the censuses are conducted concurrently, the data gathering procedures are identical to those described for the large mammal aerial surveys. When livestock are sighted during the aerial censuses, location and number of individuals are recorded into cassette tape recorders.

b. Utilization of Existing Information - Data regarding grazing history and tract use by domestic livestock were obtained from Bureau of Land Management (BLM) cattle allotment records. These records contain information on stocking rates, animal numbers, and season of utilization in the vicinity of Tract C-a.

3. Data Summary

a. Aerial Censuses - Domestic livestock censuses were conducted approximately every two months during the past year commencing with a November 8, 1974 aerial survey. On that day, 24 of 26 cattle observed on the tract were in the northeast corner of Tract C-a (section 34). Various sized groups of cattle were widely distributed over the study area, most heavily on 84 Mesa and southeast of the tract between Ryan Gulch and Black Sulphur Creek. One large group was observed on top of Cathedral Bluffs (Figure 3-7-75).

By December 30, 1974, no livestock were left on Cathedral Bluffs. Only ten cattle were seen on Tract C-a, and these were observed near the southern boundary. Small groups of cattle were scattered across the study area but

over 90% were observed in the southeast sector, between Stake Springs Draw and Black Sulphur Creek (Figure 3-7-76).

On March 4, 1975, only two groups of cattle were observed on the study area. Four were seen on Little Duck Creek at the extreme northern border of the study area, and 47 cattle were concentrated on Black Sulphur Creek (Figure 3-7- 77).

By April 14, 1975, the group on Little Duck Creek had grown to 26 head and 41 cattle were congregated in Ryan Gulch (Figure 3-7-77).

On June 26, observers noted no cattle on Tract C-a. A few small groups were seen northwest of the tract. Cattle were heavily distributed on 84 Mesa in the northeast sector of the study area, and were also observed east and southeast of Tract C-a. Thirty-six head were seen on top of Cathedral Bluffs near the Clyde Dillon Monument (Figure 3-7- 78).

On August 18, most animals were observed to have moved to higher elevations along Cathedral Bluffs and ridges perpendicular to them. Only three small groups were seen that were not in the western 1/3 of the study area (Figure 3-7- 79).

b. Utilization of Existing Information - Three Bureau of Land Management grazing allotments exist in the vicinity of Tract C-a. They are described as follows (G. Peternel, Range Conservationist, Meeker BLM Office, personal communication, 1975 allotments shown in Figure 3-7- 80):

- Reagle Allotment - 23,753 A of BLM lands and 2,190 A of private lands for a total of 25,943 A. The grazing season extends from May 3 to September 15, The BLM has recommended a stocking rate of 1,266 AUM's (Animal Unit Months) for this period. This allows 20.5 A/AUM. Actual use of the allotment in 1974 was approximately 40% higher than the recommended rate. The permittee grazed cattle in the amount of 1,773 AUM's for an average of 14.6 A/AUM.
- Square S Allotment - 64,050 A of BLM lands, 9,437 A of private lands for a total of 75,793 A. The grazing season is from May 5 through

November 25. The BLM has recommended stocking rate of 3,330 AUM's or 22.7 A/AUM. Last year (1974), the permittee stocked the allotment at less than 60% of that rate. Only 1,957 AUM's were stocked for a use ratio of 38.7 A/AUM.

- Box Elder Allotment - 26,071 A of BLM land 2,210 A of D.O.W. lands, and 1,970 A of private lands result in a total allotment of 30,251 A. The grazing season is from June 23 through October 8. The BLM has recommended a stocking rate of 1,400 AUM's for a ratio of 21.6 A/AUM. The permittee stocked the allotment at a rate approximately 24% higher than the recommended rate; actual use was 1,733 AUM's or a ratio of 17.5 A/AUM.

4. Discussion - Cattle distribution and dispersal were dictated mainly by herding, but elevational and seasonal changes on the range are also important considerations. The cattle moved to higher elevational ranges in the spring as the snowpack receded and vegetation became green. In the fall, inclement weather conditions forced the cattle to return to lower elevation rangelands.

Two of the three BLM grazing allotments in the study area were stocked last year at rates exceeding those recommended by the agency. The Reagle Allotment was overstocked by 40% (50 AUM's over). The recommended stocking rate for the Box Elder Allotment was exceeded by 24% (333 AUM's over). The Square S Allotment was stocked at only 60% of the recommended rate, 1,373 AUM's less than the amount specified in the permit.

Figures for the

Domestic Livestock Section

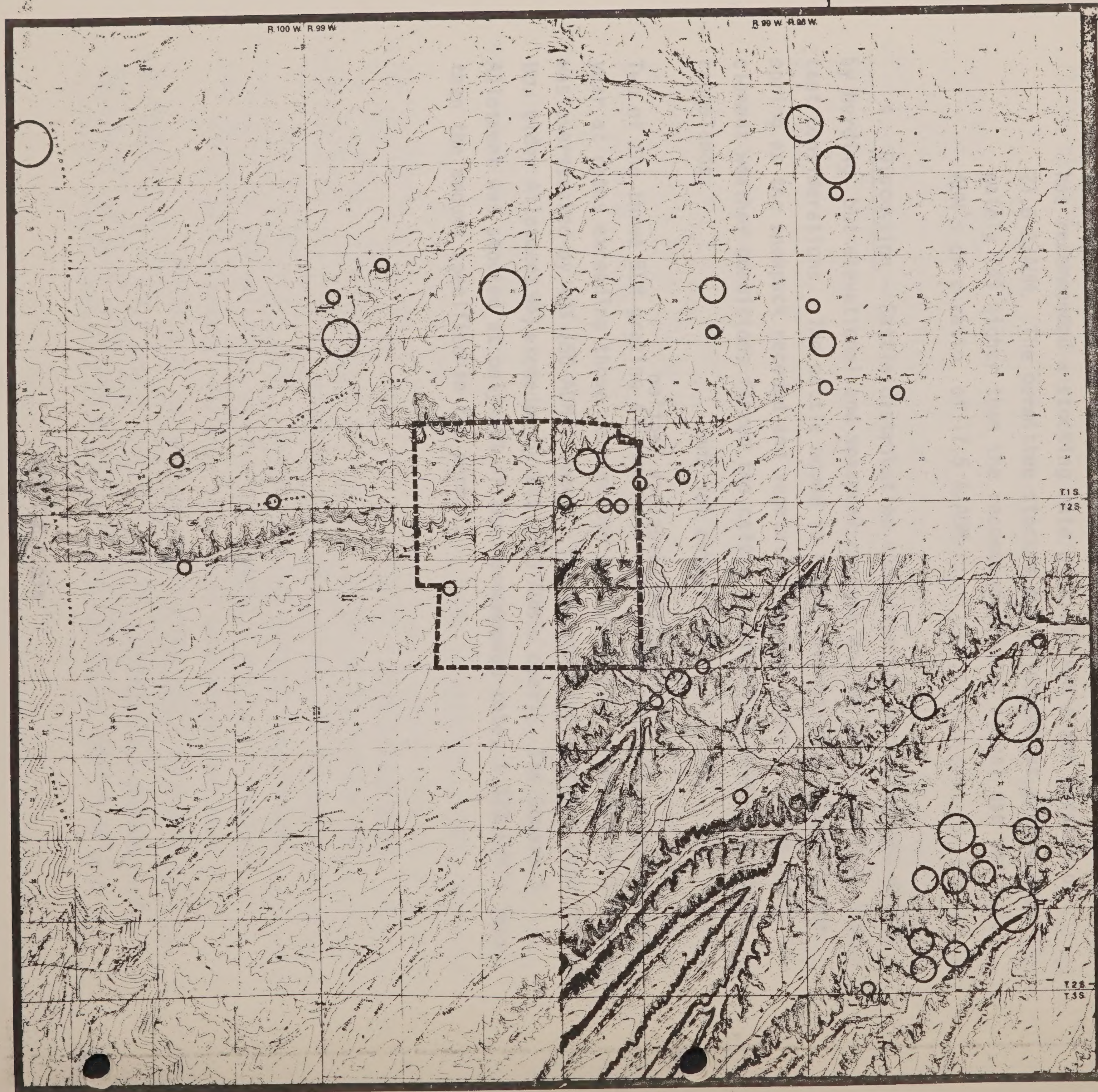


Figure 3-7-75

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

AERIAL SURVEYS

DISTRIBUTION OF DOMESTIC LIVESTOCK NOVEMBER 1974

1-4
5-10
11-20
21-35

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

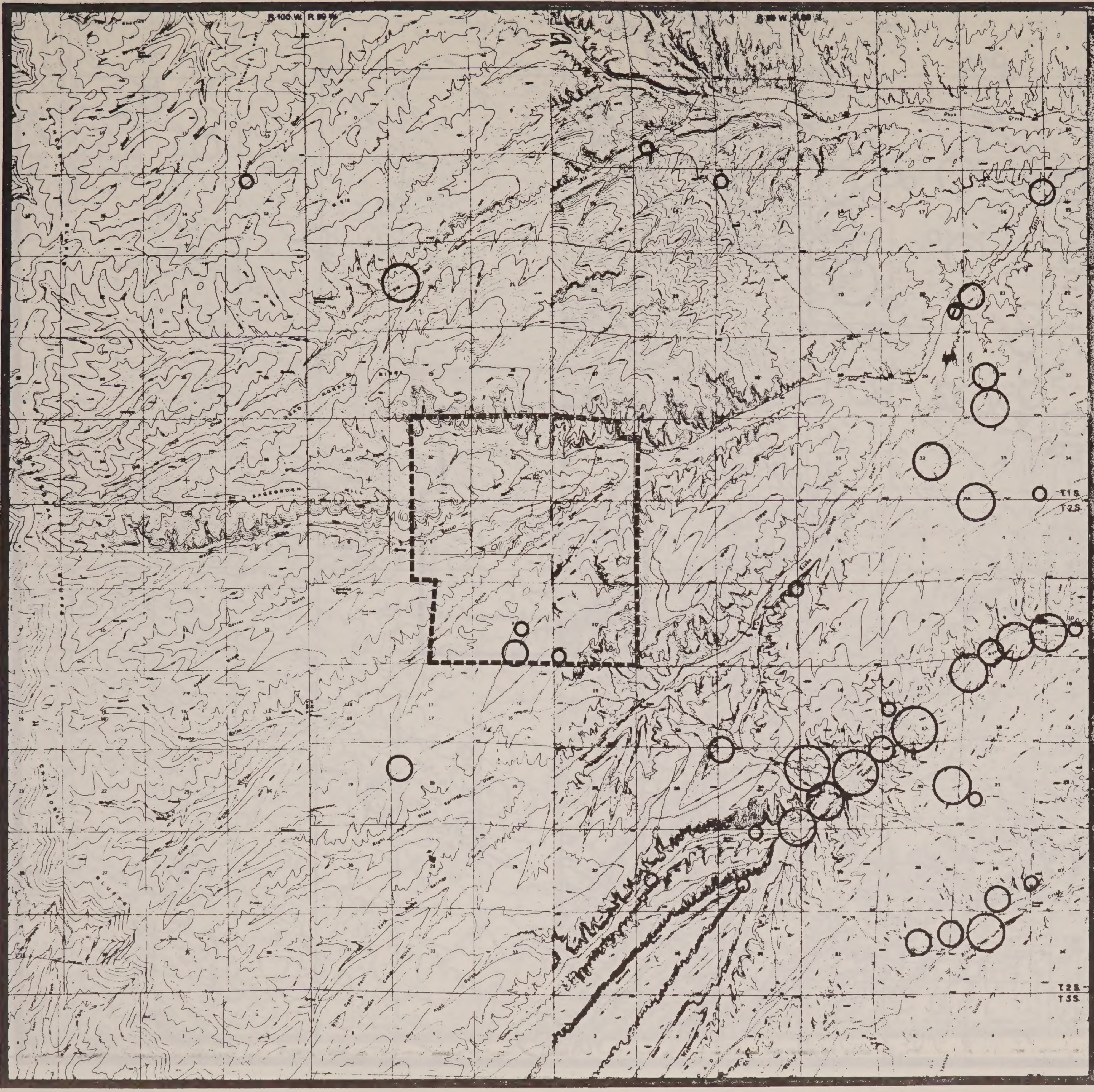


Figure 3-7-76

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

AERIAL SURVEY

DISTRIBUTION OF DOMESTIC LIVESTOCK DECEMBER 1974

- 1–4
- 5–10
- 11–20
- 21–35

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

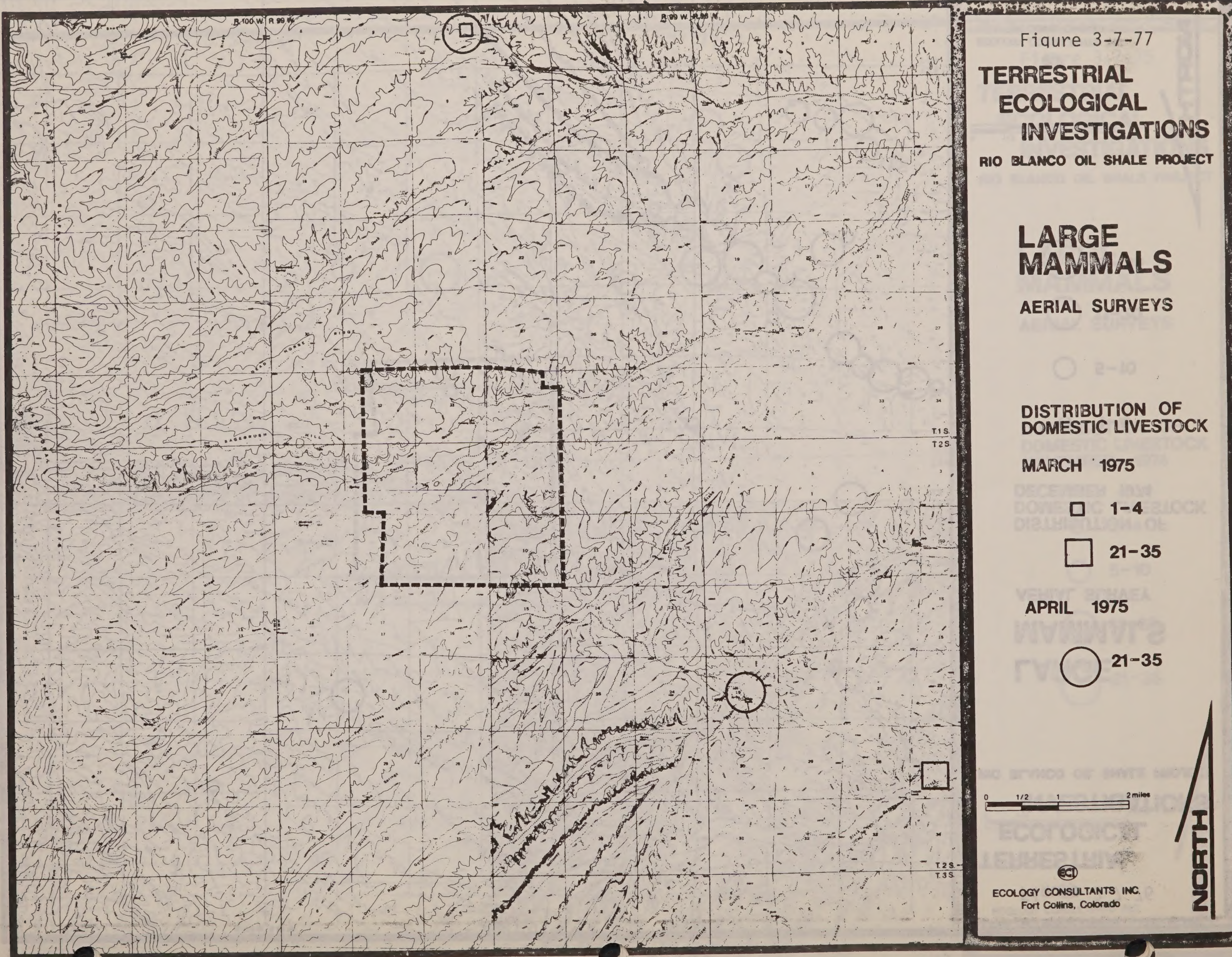


Figure 3-7-77
TERRESTRIAL ECOLOGICAL INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
LARGE MAMMALS
AERIAL SURVEYS
DISTRIBUTION OF DOMESTIC LIVESTOCK
MARCH 1975
1-4
21-35
APRIL 1975
21-35
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R.100 W. R.99 W.
R.99 W. R.98 W.
T.1 S.
T.2 S.
T.2 S.
T.3 S.

Figure 3-7-78

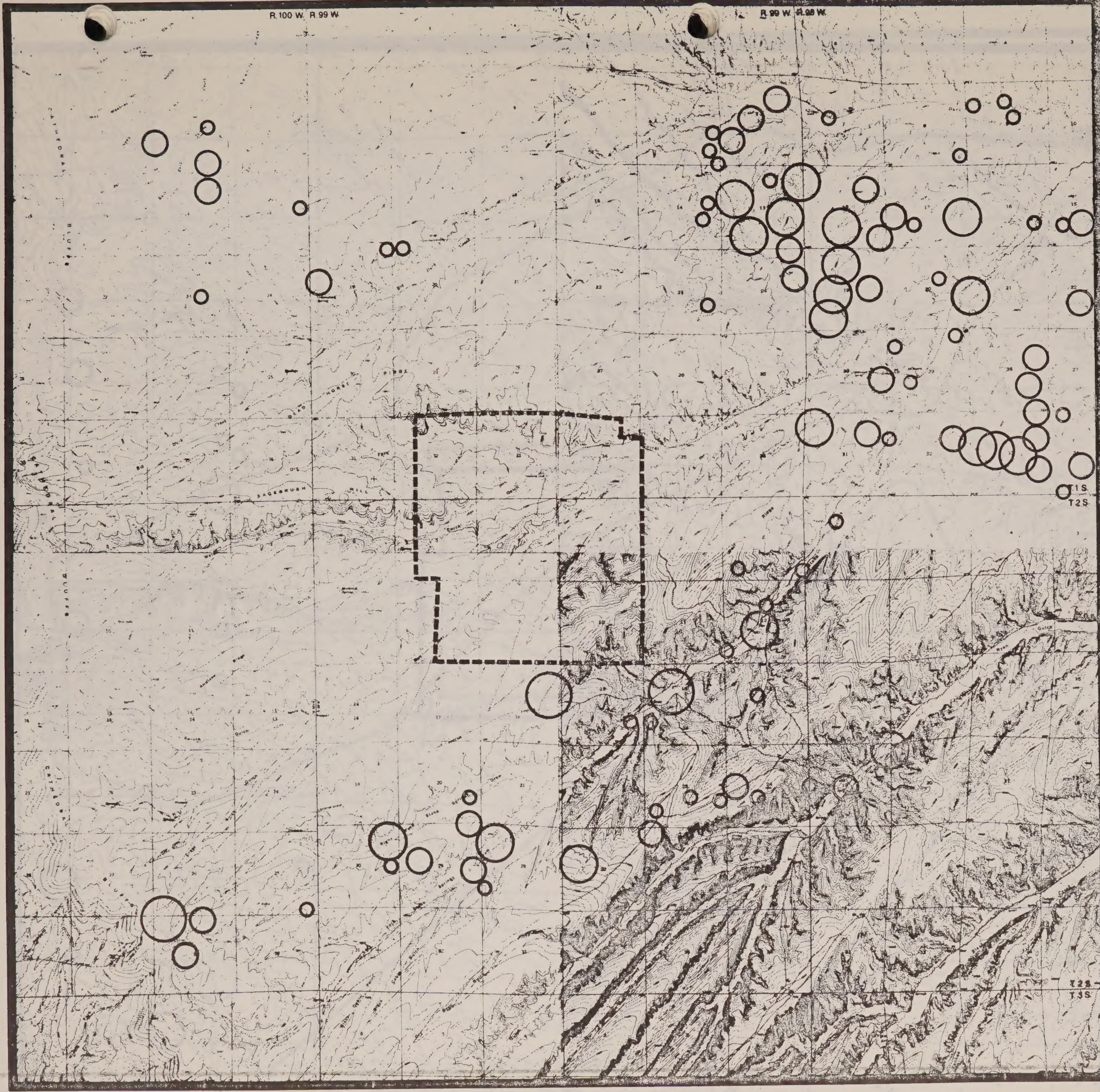
TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LARGE MAMMALS

AERIAL SURVEYS

DISTRIBUTION OF DOMESTIC LIVESTOCK JUNE 1975



1-4

5-10

11-20

21-35

0 1/2 1 2 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

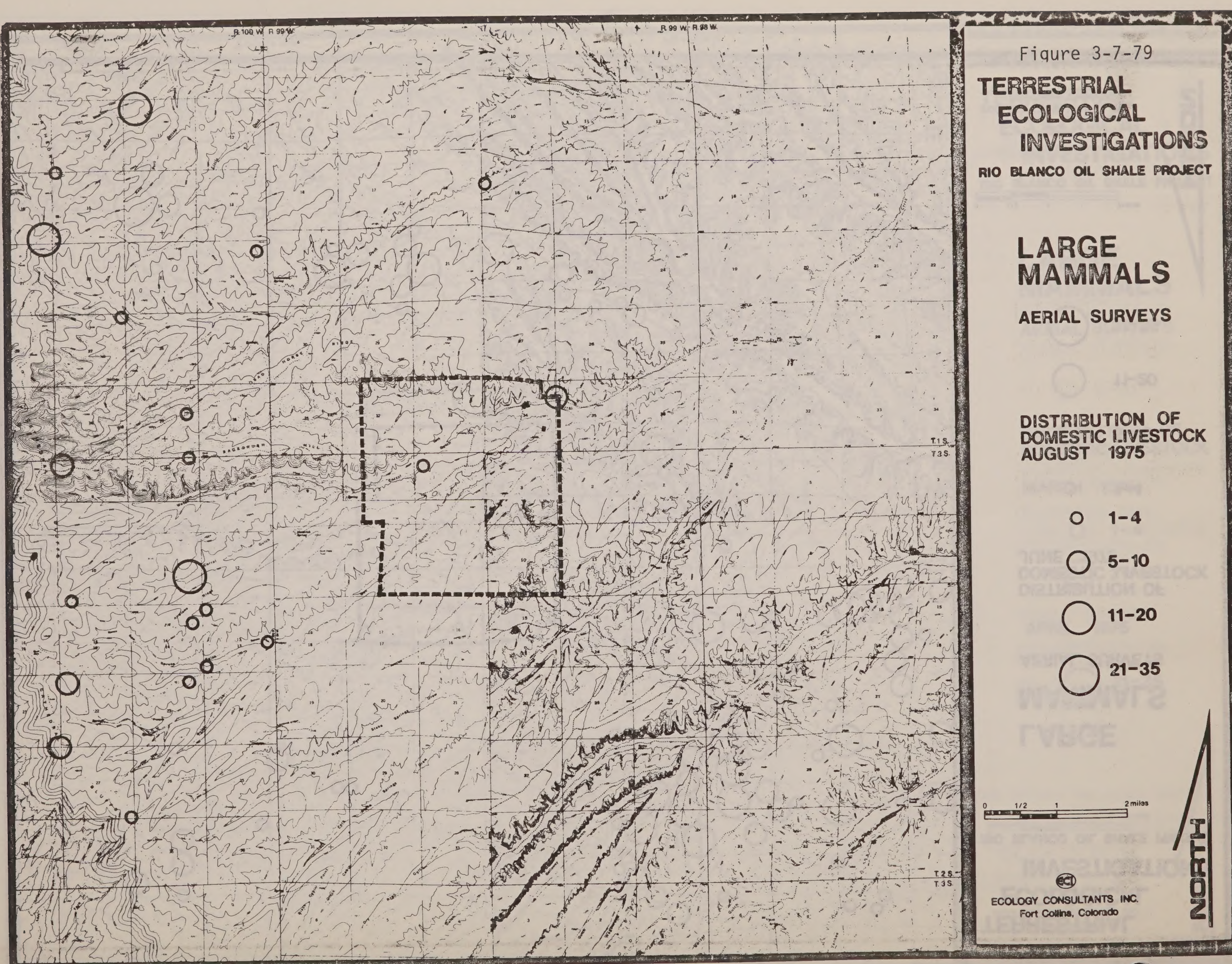


Figure 3-7-79
TERRESTRIAL ECOLOGICAL INVESTIGATIONS
RIO BLANCO OIL SHALE PROJECT
LARGE MAMMALS
AERIAL SURVEYS
DISTRIBUTION OF DOMESTIC LIVESTOCK AUGUST 1975
1-4
5-10
11-20
21-35
0 1/2 1 2 miles
NORTH
ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado
R 100 W R 99 W
R 99 W R 98 W
T 1 S
T 2 S
T 2 S
T 3 S

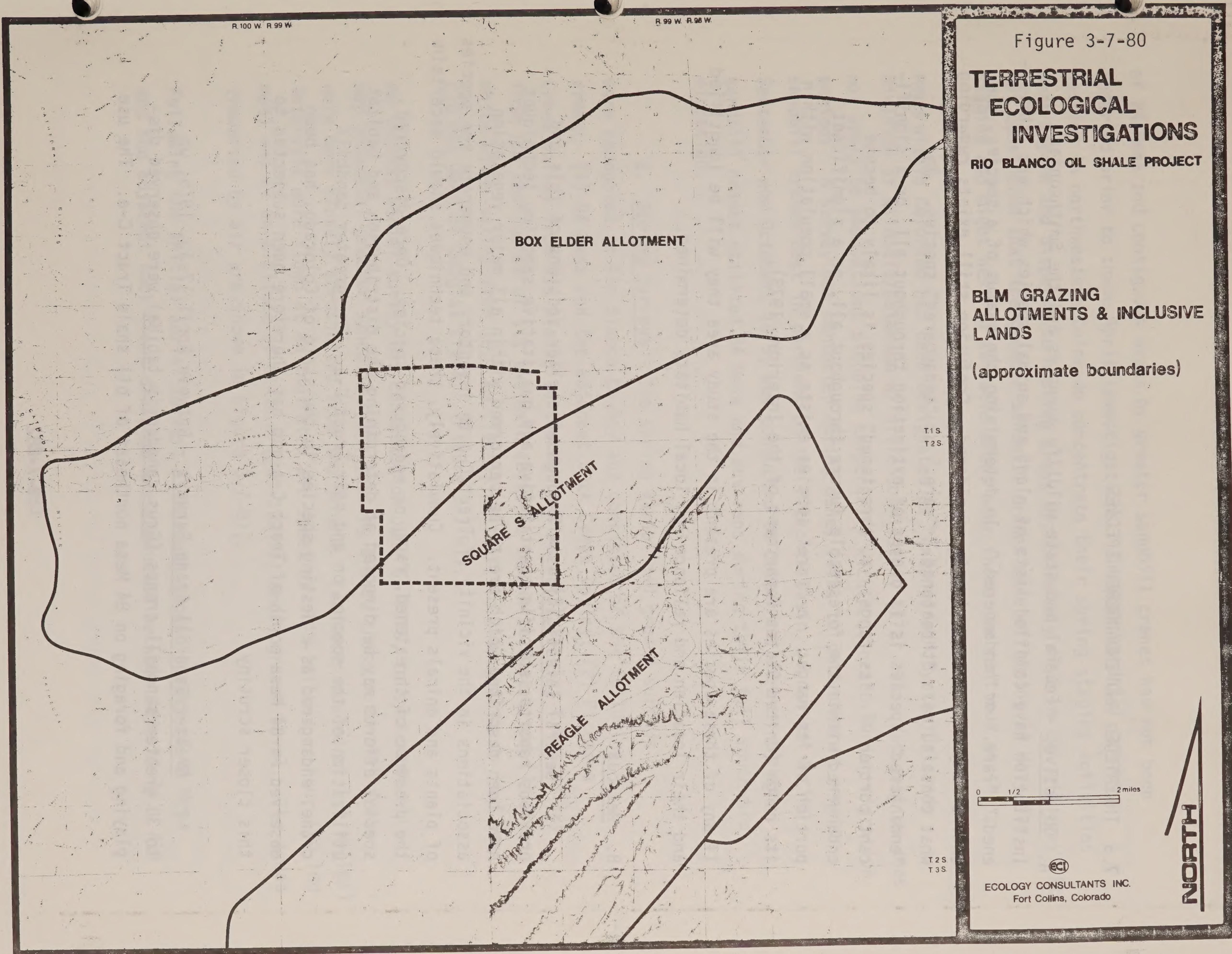


Figure 3-7-80

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

BLM GRAZING ALLOTMENTS & INCLUSIVE LANDS

(approximate boundaries)

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

7.3 THREATENED AND ENDANGERED SPECIES

A. Objectives - Federal and state wildlife agencies and the Smithsonian Institution have compiled lists of plant and animal species which are "threatened," "rare," or "endangered." In determining the status of a species, the entire range of that species is considered. Confusion still exists regarding what constitutes a "threatened," "rare," or "endangered" species. An "endangered" species is in danger of extinction throughout all, or a significant portion of, its range; a "threatened" species is likely to become endangered within the foreseeable future throughout all, or a significant portion of its range; a "rare" species exists as a small population within its range (United States Department of the Interior, 1973).

If any of these species are present in the study area they will be identified and their location and reliance on local habitats determined.

B. Methods

1. General Investigations - Throughout earlier sections of this and previous reports, specific quantitative and qualitative sampling techniques have been described which are to be performed within all major vegetation associations in the vicinity of Tract C-a to inventory and enumerate the species of plants and animals present. Cumulatively, these techniques should ascertain the presence of threatened, rare, or endangered species. Once discovered, special efforts may be directed at determining the distribution and habitat utilization of the species on and near Tract C-a. The greater sandhill crane, endangered as a nesting species in the state of Colorado, has been observed on 84 Mesa north of Tract C-a and has therefore been subjected to this closer scrutiny.

2. Greater Sandhill Crane Surveys - Between April 17-30, 1975, up to 30 greater sandhill cranes (*Grus canadensis tabida*) were observed displaying and foraging on 84 Mesa northeast of oil shale Tract C-a. The use

of 84 Mesa and contiguous areas by greater sandhill cranes had not been reported prior to these April investigations. Greater sandhill cranes nesting in northwestern Colorado concentrate their spring staging activities near Hayden and disperse to nesting areas approximately 40.2 km (25 mi) away. It was considered that the greater sandhill cranes were utilizing 84 Mesa for staging and might nest in suitable areas near there, or continue north to Idaho, Wyoming, or Montana. The population of greater sandhill cranes that nests within Colorado has been designated as "endangered" by the Colorado Division of Wildlife/Colorado Wildlife Commission, 1973. This designation does not apply to populations stopping temporarily within Colorado during migration periods. A survey was conducted during June, 1975, to determine if greater sandhill cranes nest in portions of the Piceance Basin. A survey during September and October, 1975, was conducted to determine whether greater sandhill cranes utilized 84 Mesa and environs during their fall southward migration.

a. Spring Surveys - The spring aerial and ground surveys were conducted in Rio Blanco County and consisted of the following areas: (1) 84 Mesa and the adjacent Duck Creek valley; (2) Piceance Creek valley from Rio Blanco to the White River; (3) Douglas Creek valley from the confluence of its two main forks to the White River; and (4) the White River valley from 16.1 km (10 mi) east of Rio Blanco Lake to 16.1 km (10 mi) west of Douglas Creek. (Figure 3-7-81).

An initial aerial survey was conducted on June 6, 1975, to systematically map potential greater sandhill crane nesting areas; these potential areas were more closely scrutinized from the ground. Transects spaced at 1.6 km(1mi) intervals were flown at an indicated air speed of 145-161 km per hour (90-100 mph) and at an altitude of 61-76 m (200-250 ft) above ground level. The areas traversed by air are shown in Figure 3-7-81).

Following the initial aerial survey, a thorough ground survey of 84 Mesa and the adjacent Duck Creek drainage was conducted between June 11-16. All

locations of greater sandhill cranes sighted in earlier work were checked. Since free water is essential to cranes for nesting habitat (Walkinshaw, 1965), valleys were explored for water at 1.61 km (1 mi) intervals or whenever rough-winged swallows, which are common near water, were observed foraging above the valleys. When water was present, the length of the drainage was examined for cranes and/or their footprints.

The ground survey of the remaining potential nesting habitats was completed between June 26 and July 4. The vehicle was stopped approximately every .48 km (0.3 mi), and the area was thoroughly scanned with 7 x 35 binoculars and/or a spotting scope. Areas that were inaccessible by truck or that afforded particularly good crane habitat were traversed on foot. Littlefield and Ryder (1968) described good greater sandhill crane breeding habitats as tracts having minimal disturbances, a feeding meadow, nesting cover, and nearby water. These criteria were used in designating greater sandhill crane breeding habitat in this study.

On June 30 at 0640, a final aerial survey was conducted to reexamine potential nesting sites for greater sandhill cranes and to determine where further ground survey efforts should be concentrated. Indicated air speed ranged from 129-145 km per hour (80-90 mph) at an altitude of 46-53 km (150-175 ft) above ground. Air and light conditions were excellent, providing for good visibility. The portion of the White River within the study area was flown three times because it contianed the best potential nesting habitat. Douglas Creek was flown twice and Piceance Creek once. The confluences of the major tributaries to the above stream courses were also recanvassed for location of possible nesting sites.

During the two ground surveys, residents of the study area were interviewed to determine whether they had observed cranes in the area. The interviewees were asked if they had seen any large birds in the area and, if so, to describe the birds. It was determined by inquiry whether the residents were possibly confusing greater sandhill cranes with great blue herons,

the only other bird in the study area of comparable general appearance. Residents who were not initially familiar with the greater sandhill crane or did not describe it properly were shown several photographs of the bird to determine if they then recognized it. Residents that were familiar with greater sandhill cranes were also shown pictures.

b. Fall Surveys - The fall survey area, located on 84 Mesa (Figure 3-7-81), was restricted to those portions of the mesa dominated by big sagebrush. The topography of this xeric mesa varies from flat to slightly rolling.

The area was ground-surveyed four times. The initial survey, on horseback, commenced September 4, 1975. The remaining surveys occurred September 13-14, 1975, on horseback and foot; September 19-20, 1975, on foot; and September 30, 1975, on horseback and vehicle. Transects were spaced at intervals that would insure complete coverage of the area. The transect interval was reduced in the area where greater sandhill cranes were observed during April, 1975. The areas covered during the four surveys are represented Figure 3-7-81). The area was thoroughly scanned with 7 x 35 binoculars and/or a 20x spotting scope.

On October 8, 1975, a flock of greater sandhill cranes was observed by ECI personnel near the confluence of Piceance Creek and Ryan Gulch. Following that observation, a thorough ground survey of 84 Mesa and Piceance Creek by vehicle was conducted. Residents were interviewed to determine whether they had observed any cranes in the area. An aerial survey was conducted on October 9, 1975, and covered the following areas: (1)Piceance Creek valley from Rio Blanco to the White River; (2) Tract C-a; (3) 84 Mesa and nearby gulches; and (4) Yellow Creek to the White River. The survey was flown at an altitude of approximately 46 m (150 ft) above ground level and at an indicated air speed of 121-129 km per hour (75-80 mph). An additional aerial survey was conducted on October 22, 1975, and covered the same areas of the October 9, 1975 survey. This survey was flown at an altitude of approximately 61 m (200 ft) above ground level because of turbulence.

On November 4, 1975, ECI was notified that two flocks of greater sandhill cranes were observed on 84 Mesa on October 25, 1975. Following that observation, a ground survey of 84 Mesa, Duck Creek, and Yellow Creek was conducted November 4 and 5, 1975, by Limnetics' biologists. During the regular mule deer and raptor census flight of November 6, 1975, time was taken to survey 84 Mesa and environs for greater sandhill cranes.

C. Data Summary

1. General Investigations - One plant species, an endangered milkvetch (*Astragalus lutosus*, Smithsonian Institution, 1975), and two animal species, the endangered peregrine falcon (*Falco peregrinus anatum*) (United States Department of the Interior, 1974) and the endangered, if nesting in Colorado, greater sandhill crane (*Grus canadensis tabida*) (Colorado Wildlife Commission, 1973), have been observed in the study area to date. The prairie falcon, which was listed as threatened by the United States Department of the Interior (1974) but has recently been dropped from the list (United States Department of the Interior, 1975), is included here because of its status during the reporting year. Locations of all sightings of these species are presented in Figure 3-7-82.

During the reporting year 1975, two specimens of the rare milkvetch were found growing on shale outcroppings on Cathedral Bluffs and Dead Horse Ridge. Two of the four peregrine falcons observed were on Tract C-a. One peregrine falcon was observed in Swizer Gulch in April 1975; one on Wolf Ridge in June, 1975; one on Airplane Ridge in July, 1975; and one in Corral Gulch drainage in August, 1975 (Figure 3-7-82). Seven observations of adult prairie falcons occurred on the study area: one at the confluence of Corral Gulch and Stake Springs Draw during December, 1974; one on Wolf Ridge in May, 1975; two on Cathedral Bluffs in June, 1975; one on Tract C-a in Corral Gulch in June, 1975; and two in Stake Springs Draw in July, 1975.

Because of their high mobility, it is not feasible to say exactly how many different individual peregrine or prairie falcons were observed. Also, the high mobility of these species and the low number of observations preclude the designation of habitat preference for either species in the study area.

Nests were not observed for either species during regular raptor surveys in the study area.

2. Greater Sandhill Crane Surveys

a. Spring Surveys - No greater sandhill cranes were observed in any of the areas examined by air or on the ground during the spring surveys. The White River valley, with its willow swamps and nearby grainfields, provided the best potential breeding habitat. Two other potentially appropriate nesting areas were located on Duck Creek and Big Duck Creek. Both areas provide year-round water. Cottonwoods are located at the potentially suitable breeding site near Big Duck Creek while dense aquatic vegetation and insects are prevalent at the site on Duck Creek. After air and ground survey, many of the smaller creeks were ruled out as providing suitable nesting sites because they did not meet one or more of the requirements for suitable nesting sites as itemized in the methods section.

Conversations with area residents provided no evidence that greater sandhill cranes are nesting in the vicinity of 84 Mesa or elsewhere in the Piceance Basin. However, an employee of Ecology Consultants, Inc. reported observing a single greater sandhill crane flying near the junction of Piceance Road and the White River on June 26, 1975. Many residents described the great blue heron as a recurring visitor in their locality and did not recognize the photographs shown to them of greater sandhill cranes. Several residents reported that although they were familiar with the greater sandhill crane, they had not observed any in the vicinity. Some residents along the White River described seeing several too many cranes land in their field or along the river during past migration periods, but these birds never

remained for extended periods. One rancher on Piceance Creek reported that several cranes foraged along the creek during the high winds and rainy period of April, 1975. It appears that cranes have visited the White River and Piceance Creek in past years, but no resident knows of any having actually nested in the survey area.

b. Fall Surveys - Greater sandhill cranes were not observed during the scheduled fall ground surveys. On October 8, 1975, a flock consisting of 13 adult and seven juvenile cranes was observed flying .8 km (.5 mi) east of the confluence of Ryan Gulch and Piceance Creek. Conversations with local ranchers and Tract C-b personnel revealed that a flock of 19-20 greater sandhill cranes was observed on the Weidland Ranch on Piceance Creek several days prior to ECI's October 8th observation. The cranes observed by C-b personnel and local ranchers may have been the same flock which ECI personnel observed foraging along Piceance Creek. All observations occurred in the same general area within a few days of each other, and approximately the same numbers of cranes were observed by ECI personnel, local ranchers, and Tract C-b personnel.

The aerial survey on October 9, 1975, revealed one greater sandhill crane standing in the Piceance Creek bottom approximately 6.8 km (4.25 mi) north of the confluence of Piceance Creek and Ryan Gulch.

The aerial survey on October 22, 1975, was scheduled to coincide with the peak of migration (V. Salt, Bureau of Sport Fisheries and Wildlife, personal communication, 1975). Greater sandhill cranes were not observed during this survey. Solitary cranes, if present, were not detectable because turbulence and high velocity winds prohibited flying at a low altitude. On October 25, 1975, two flocks of greater sandhill cranes were observed on 84 Mesa by Dr. Alan Olson, the archaeological contactor for Rio Blanco Oil Shale Project. The flocks, consisting of five and six greater sandhill cranes, were observed approximately 1.6 km (1 mi) northwest of 84 Ranch. However, during the surveys conducted by Limnetics personnel on November 4-6, no sandhill cranes were observed.

D. Discussion

1. General Investigations - Habitats of rare plants are often geologically young or unstable: i.e., talus slopes, mountain tops, rock cliffs, or shale barrens (Smithsonian Institution, 1975). The endangered milkvetch, *Astragalus lutosus*, is known only to occur on dry calcareous shales at lower elevations in the drainages of the White River, Rio Blanco County, Colorado, and adjacent areas of Utah.

The Piceance Creek region, according to Bunneby (cited in Munz, 1949), "is one of the two known locations of the very rare *Astragalus lutosus* ... (The region is) part of the great Green River shale deposits, so rich in endemics to the west." Both specimens of the rare milkvetch were found growing on shale outcroppings.

There are three subspecies of the peregrine falcon in North America: *Falco peregrinus anatum*, *Falco peregrinus tundrius*, and *Falco peregrinus paelei*. Both *Falco peregrinus anatum* and *Falco peregrinus tundrius* are endangered. Breeding populations of the endangered *Falco peregrinus anatum* have declined in the Rocky Mountain region of their range during the last twenty years. During 1974, five *Falco peregrinus anatum* pairs in Colorado were successful in producing fledglings. Only three nesting pairs were successful in 1975 (G. Craig, Colorado Division of Wildlife, personal communication, 1975). Four peregrine falcons were observed on the study area during the reporting year of 1974-75; two of the four sightings were on Tract C-a. It is impossible to determine how many individuals (from one to four) the four sightings represent because of their high mobility. However, the sightings, in all probability, were the *Falco peregrinus anatum* subspecies since the observations occurred prior to the fall migration of the *Falco peregrinus tundrius* subspecies. The first migrating "tundra" falcons reach north-central United States in early September (Enderson, 1965). Peregrine falcon sightings on Tract C-a occurred during the spring and summer, 1975.

The status of the peregrine falcon(s) observed in the study area is unknown. The falcon(s) could have been either (a) solitary adult(s) hunting, (b) one of a pair nesting in the area, or (c) an immature. A basic component of the peregrine falcon's habitat is a cliff. Peregrine falcons are restrictive in the selection of their eyrie sites (Snow, 1972). Preferred cliffs are usually high, in close proximity to water, and favor a north-east directional orientation. The mean height of peregrine falcon nests in Utah was 54.3 m (178 ft) (Porter and White, 1973). In Colorado, all of the fifteen nests visited were on cliffs more than 70 m (210 ft) high (Enderson. 1965). Most peregrine falcon eyries in Utah were found on east and north facing cliffs and were predominently on open ledges under a cliff overhang (Porter and White, 1973).

Peregrine falcons often nest in the vicinity of rivers (Enderson. 1965). All of the 40 suspected eyries in Utah were in close proximity to water. i.e., rivers, marshes, lakes, and streams (Porter and White, 1973). Bend (1946, cited in Porter and White, 1973) reported that peregrine falcons in the western United States seldom nested more than 0.8 km (0.5 mi) from water in which to bathe. Furthermore, peregrine falcons are restrictive in their food habits; "water-type" birds are generally the preferred prey although the prergrine falcon does utilize other avian species for food. Of the available cliffs in the area, Cathedral Bluffs meets one nesting requirement, preferred directional facing of the cliff. However. an available source of water and food in close proximity to Cathedral Bluffs and cliff height appear to be the limiting factors in the nesting potential of the area.

Gerald Craig of the Colorado Division of Wildlife supported the conclusion that the study area does not contain prime nesting habitat for the peregrine falcon. Thus, the peregrine falcon(s) observed were probably utilizing the study area and environs for hunting purposes only. A potential peregrine falcon eyrie exists approximately 32 km (20 mi) southeast of the study area and according to Mr. Craig, peregrine falcons could be hunting as far as 32 km (20 mi) away from the eyrie.

Prairie falcon populations in Colorado through 1965 were reported as stable (Enderson, 1969, cited in Garrett and Mitchell, 1973). During 1974, approximately 89 prairie falcon pairs reproduced successfully in Colorado (G. Craig, Colorado Division of Wildlife, personal communication, 1975).

There were seven observations of the threatened prairie falcon on the study area during the reporting year, 1974-1975. Again, as with the peregrine falcon, the exact number of individuals that these sightings represent is impossible to determine because of the falcons' mobility.

The use of the study area for nesting or foraging is presently unknown. Although this area contains better nesting sites for the prairie falcon than for the peregrine falcon, the nesting prairie falcon population in the Piceance Basin is small (G. Craig, Colorado Division of Wildlife, personal communication, 1975). The prairie falcon uses a wide variety of nesting sites; potholes, rock crevices, trees, nests of other species of raptors, and open cliff ledges. Documented mean heights of prairie falcon eyries are recorded by Porter and White (1973) in Utah [20 m (64 ft)], by Enderson (1964) in Colorado and Wyoming [11.1 m (34.7 ft)], and by Leedy (1972, cited in Porter and White in Montana, 1973) [24.4 m (80 ft)]. The prairie falcon exhibits a preference for south-and west-facing slopes (Enderson, 1964; Porter and White, 1973). Of the available cliffs in the area. Cathedral Bluffs offer the best eyrie sites because of directional facing and cliff height. Observation of a pair of prairie falcons on Cathedral Bluffs in June, 1975, further supports the possibility of an active eyrie in this region of the study area.

The prairie falcon shows less selectivity in choice of food for its young than does the peregrine. The prairie falcon feeds on small mammals, reptiles , and ground-dwelling and passerine birds, all of which abound in the study area.

The range of nesting dates in Utah County, Utah was April 18 - June 15 (data from Bee and Hutchings, 1972, cited in Porter and White, 1973). Porter and Poorman (unpublished notes, cited in Porter and White, 1973) reported data of young prairie falcons capable of flight by June 10. If the pair of prairie falcons were nesting in Cathedral Bluffs, they were observed near the probable end of their nesting season.

Observations of prairie falcons could be either non-breeding individual(s) hunting in the area or member(s) of a possible nesting pair from Cathedral Bluffs foraging after the nesting season.

2. Greater Sandhill Crane Surveys

a. Spring Surveys - It is not known if the cranes observed staging on 84 Mesa during April, 1975, are Colorado nesters. The results of the spring aerial and ground reconnaissance combined with personal interview data provided no evidence that greater sandhill cranes nest in the areas in and around 84 Mesa. But, according to Blake (1974), when the young are a couple of days old, the adult birds lead them to higher ground or into the sagebrush to feed. Thus, the second portion of the ground survey may have occurred when adults had already led their young to feeding areas away from the water. Aerial and vehicle search for cranes may miss birds during the incubation period, due to the wariness of the birds and their ability to blend with the surrounding environment (W. Graul, personal communication 1975). Therefore, it is possible that the greater sandhill cranes observed staging in April, 1975 are Colorado nesters even though they were not detected during the study. They may be a local Rocky Mountain breeding flock that has gone unnoticed over the past years, or, because pioneering local birds seem to be moving into habitats which were historically occupied (Blake, 1974), a recent population may possibly have reinhabited the area. Reports from several residents on the White River and Piceance Creek concerning occasional sightings of cranes during past migration periods also suggest that the flock could have been a transient group foraging on 84 Mesa. It is undetermined if the observed greater sandhill cranes use these sites year after year or on an occasional basis.

b. Fall Surveys - The possible use of 84 Mesa as a fall staging area was investigated during September and October, 1975. Two flocks of greater sandhill cranes were observed on 84 Mesa on October 25, 1975.

Greater sandhill cranes usually remain for 2-7 weeks at a fall staging area prior to their southward migration (Drewien and Bizeau, 1974). However, surveys of 84 Mesa that occurred on October 22 and November 4-6, 1975, during the peak of migration, did not reveal greater sandhill cranes. Thus, the two flocks observed probably utilized 84 Mesa as a temporary resting and foraging area during their southward migration.

The status of the flock observed October 8, 1975, near the confluence of Piceance Creek and Ryan Gulch is unknown. Some cranes migrating southward from northern staging areas will occasionally stop at staging areas farther south (Drewien and Bizeau, 1974). Greater sandhill cranes generally require available grain in proximity to an adequate water supply for their fall staging area (Drewien and Bizeau, 1974), but 84 Mesa does not seem to meet these criteria. In the fall, greater sandhill cranes generally move to the major staging area nearest their summer nesting site. Reports from several residents in the White River and Piceance Creek concerning occasional sightings of cranes during past migration periods suggest that portions of the Piceance Creek Valley may serve as foraging sites for transient cranes. Thus, the flock observed on October 8, 1975, could have been either foraging and/or staging along Piceance Creek.

3. Summary - One endangered plant and three endangered, threatened, or threatened if nesting animal species were observed on the study area during the reporting year 1974-1975. Two individual observations in the study area of milkvetch (Astragalus lustosus), 4 observations of the peregrine falcon (Falco peregrinus anatum), 7 observations of the prairie falcon (Falco mexicanus), and approximately 40 observations of the greater sandhill crane (Grus canadensis tabida) were recorded. There

were no known nests for the avian species encountered. Based on observations made during the spring and fall surveys, 84 Mesa and the surrounding environs may serve as a staging and foraging area for greater sandhill cranes during their spring and fall migrations.

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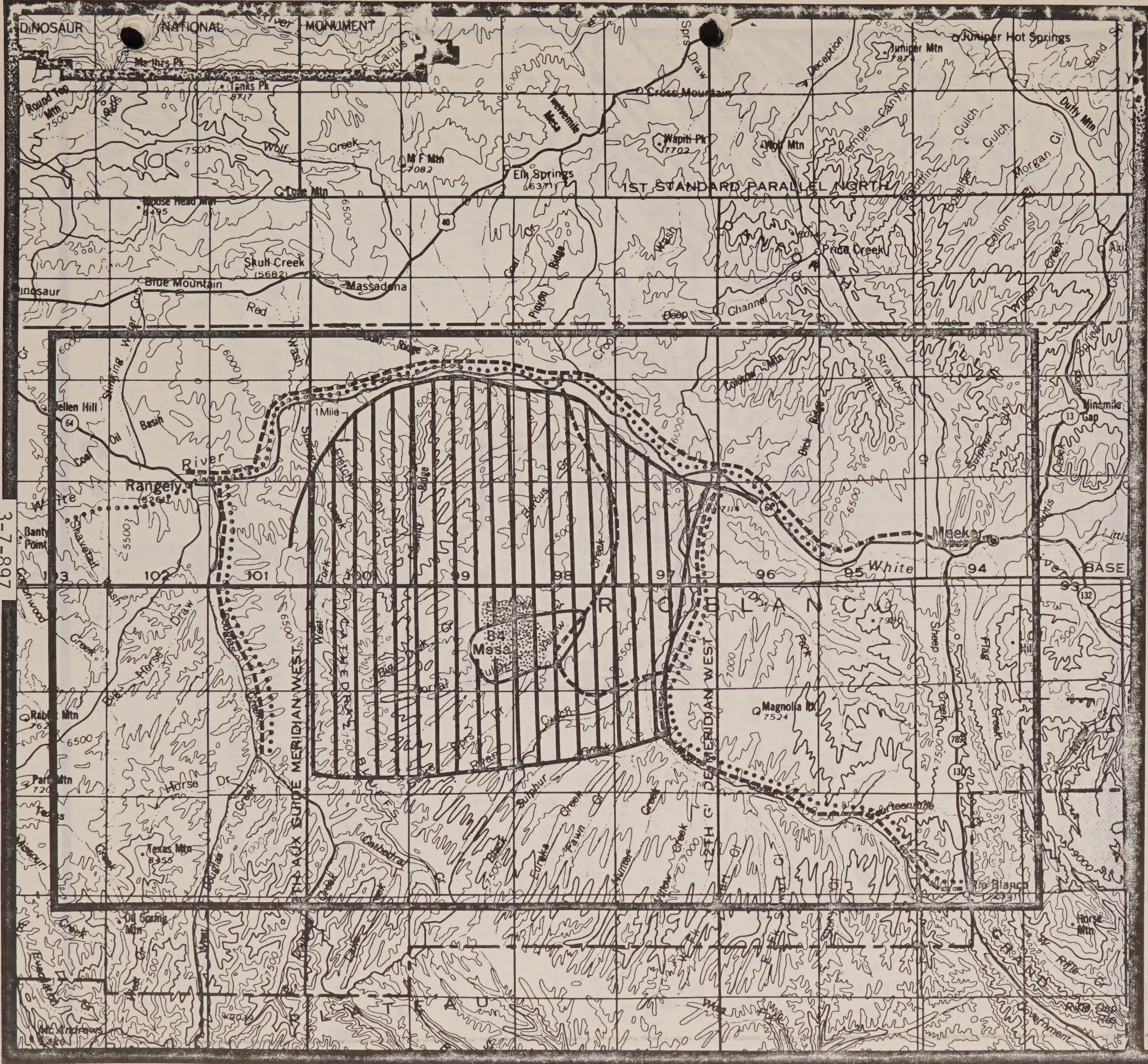
Figures for the

Threatened and Endangered Species Section

Figure 3-7-85

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT



SANDHILL CRANE STUDY AREA

- STUDY AREA BOUNDARY
- AREA COVERED BY AERIAL SURVEYS
- AERIAL DRAINAGE SYSTEM TRANSECTS
- VEHICLE SURVEY
- FALL GROUND SURVEYS

0 1.5 3 6 miles

NORTH

ECOLOGY CONSULTANTS INC.
Fort Collins, Colorado

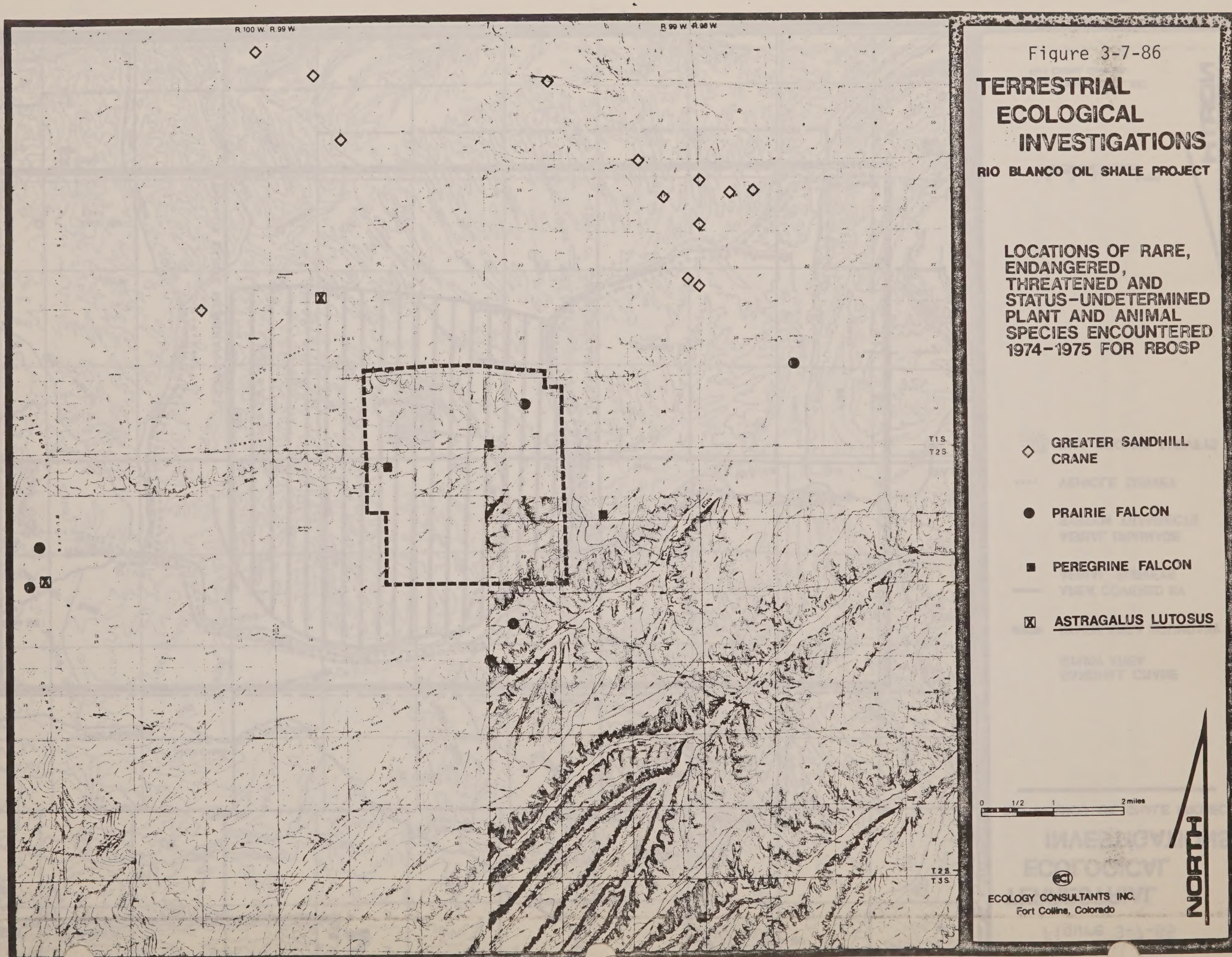


Figure 3-7-86

TERRESTRIAL ECOLOGICAL INVESTIGATIONS

RIO BLANCO OIL SHALE PROJECT

LOCATIONS OF RARE, ENDANGERED, THREATENED AND STATUS-UNDETERMINED PLANT AND ANIMAL SPECIES ENCOUNTERED 1974-1975 FOR RBOSP

7.4 TERRESTRIAL INTERRELATIONSHIPS

A. Introduction - "Ecological interrelationships" is a phrase which encompasses all interactions among the multitude of organisms existing in the ecosystems under study and all interactions of those organisms with their abiotic environment. Although scientists profess an understanding for only a small proportion of the total of interactions, even those few are too numerous to be fully discussed in this report. Instead, the objectives of the following discussion will be (1) to outline some fundamental ecological concepts and (2) to select examples of major ecosystem interactions specific to the Tract C-a vicinity, and use them to develop the reader's intuitive grasp of the basic structure and functioning of ecosystems in the Tract C-a vicinity.

Most ecological interactions can be discussed within the framework of ecosystem food webs, identifying the major pathways of energy and nutrient transfers. Organisms within food webs are commonly grouped into trophic (feeding) levels. The only significant source of energy in such a system is solar radiation absorbed by green plants and utilized in the conversion of carbon dioxide and water into energy-rich carbohydrates. For this conversion, the vegetation (referred to as the primary "producer" trophic level) is also dependent upon a suitable supply of nutrients from the soil. Thus, initially, the vegetation incorporates energy, water and nutrients from the soil. Energy-rich compounds produced in excess of the plants own requirements are stored in its tissues, ultimately providing the food base for the rest of the ecosystem.

Part of the vegetation is eventually harvested by "herbivores" (primary consumers) including certain insects, birds, reptiles and mammals, while the remainder eventually passes to decomposition. Whereas the herbivores derive their nutrition directly from green plants (producers), carnivores (secondary or tertiary consumers) feed primarily upon the herbivores or upon other carnivores. A large portion of the biomass at each trophic level (producer-primary consumer, secondary and tertiary consumer) is not harvested

by the next higher level (Boughey, 1968; Kormondy, 1969). For example, carnivores rarely consume entire prey populations.

There are several concepts fundamental to understanding the flow of energy and nutrients through trohpic levels (producers to primary consumers to secondary consumers to decomposers, for example). First, the flow is directional. With respect to energy it is noncyclic; with respect to nutirent flow, it is cyclic, with nutrients returned to the soil through the action of decomposers to again become available to producers. Secondly, because of incomplete harvesting and energy losses (i.e., to respiration, etc.) at each stage, there is a progressive decrease of energy (and usually biomass) at each successive trophic level. Thus, within a given category of organisms such as insects or birds, there would normally be more herbivores than carnivores. In fact, most ecosystems can support relatively few carnivores. Thirdly, the separation among trophic levels is based on ecological function. While the food habits of some species place them entirely within one trophic level, many animal species overlap trophic levels by consuming food from more than one other category. For example, many organisms commonly consume both animals and vegetation and are called omnivores. Thus, although it is useful to illustrate broad ecological principles in terms of discrete trophic levels such as primary producer herbivore, carnivore, omnivore, etc., complex food "webs" are more often encountered in the study of specific ecological systems.

In addition to the concepts of energy flow and nutrient cycling, another major concept involved in the following discussion of Tract C-a vicinity ecosystems involves the diversity of organisms, particularly within the lowere trophic levels. This relates to the variety of cover and food sources available for partitioning among individual species at the higher trophic levels. It is easy to visualize that a carnivorous species dependent on a

single prey population is also dependent on all those factors which affect the prey population. However, if the same carnivore has several optional food sources, it is to that extent less dependent of the factors which affect the population levels of a specific prey species. Conversely, small mammal or other prey species are less likely to achieve extremely high population levels (sometimes leading to destruction of their own habitat) if several predator species serve as controlling influences on their numbers. As a generality, those ecosystems with greater diversity in each trophic level (resulting in interactive food webs rather than linear food chains) are less likely to exhibit wide fluctuations in component species and their population levels as a result of environmental stress (Wilson and Bossert, 1971). Fluctuations that do occur in such ecosystems are less apt to induce major oscillations in other components of the ecosystem.

To this point, only food-related interactions have been outlined. However, each animal species also has unique requirements for a place to live (habitat) including protection from its predators (cover); nesting or den sites, adequate living space and safety from other threatening factors such as climatic extremes. Plant species have comparable requirements for space, light, soil moisture and nutrients. Therefore, the discussion of the habitat requirements of important local species and their tolerance limits to disturbances from outside natural systems is important to local ecosystem descriptions.

The overall food web for terrestrial ecosystems in the vicinity of Tract C-a might be visualized in terms of a compartmental flow diagram (Figure 3-7-82). Although the diagram is a gross simplification of reality and is not intended to depict all possible interrelationships, it does identify some major expected pathways of energy and nutrient flow in Tract C-a ecosystems.

Producer organisms (vegetation) are supported by nutrients in the soil and respond to the various climatic factors (e.g., precipitation, temperature, humidity, etc.). All other organisms depicted on Figure 3-7- 82 are directly or indirectly dependent upon the nutritional energy stored within the pro-

ducer trophic level. The primary consumers which feed directly upon producers may be further subdivided according to their mode of feeding or the part of the plant which they utilize. Insects consume vegetation in substantial proportions and in various ways (e.g., as grazers, sap feeders, seed predators and pollen feeders). Small mammals, mule deer and herbivorous birds normally consume vegetation in lesser proportions.

Secondary consumers are those animals which utilize primary consumers as a principal energy source, normally incorporating a small proportion of the energy available from the next lower level (MacArthur and Connell, 1966). Some insect groups (parasitic hymenopterans) and all spiders prey heavily upon herbivorous insects, for example. Raptorial birds, snakes insectivorous birds and some mammals also derive nutrition from primary consumers. Considerable energy is lost in the transfer, hence, there are far fewer secondary consumers than primary consumers. Absence of these few top level consumers, however, could permit expansion in numbers of such groups as herbivorous insects, resulting in their overeating the producer organisms upon which they depend.

Using the above discussion of general ecological principles as a basis, the following discussion draws upon recent literature for the predominant vegetation types and upon study results from the Tract C-a vicinity to develop an understanding of major site-specific ecosystem interactions. In order to focus better on the most important interactions, the following treatment will deal principally with the pinyon-juniper and sagebrush vegetation types which cover 90% of the approximately 160 sq mi study area.

B. Abiotic-Producer Interactions - The necessary first step in understanding Tract C-a ecosystems is to understand how physical-environmental factors which prevail in the area may dictate the distribution and patterning of vegetation. Vegetation patterns, in turn, control major patterns in the distribution of animals. In the semi-arid, continental climate of the Piceance Basin the "controlling" environmental factors are relatively few and act in a more straight-forward manner than is common in more humid

climates, creating a patchwork of distinctly different vegetation types which are normally separated from each other by relatively distinct boundaries or zones of transition. The primary physical environmental factor which "controls" vegetation distribution in the Tract C-a vicinity is the availability of soil moisture in plant rooting zones. Availability of soil moisture is, itself, controlled by two interacting sets of influences.

The first is the physical-chemical nature of the soil. For example, coarse-textured soils effect rapid penetration of moisture to greater depths, with moisture frequently penetrating thin surface soils and extending into fractured bedrock. Here, especially, where parent materials tend to be acidic, nutrient availability may be low. Such soils favor the growth of deep-rooted trees and shrubs, particularly evergreens like pinyon or juniper which require a permanent supply of subsoil moisture but are adapted to low nutrient conditions. Most of the subsoil moisture is derived from winter snows. Summer rainfall is ineffective, lost by runoff or evaporation (Tueller, 1975) Fine-textured soils, on the other hand, tend to retain moisture in surface horizons and favor more shallow-rooted plants or shrubs, such as sagebrush, which are adapted to the higher nutrient availability typical of arid shrub-steppe soils. However, in arid regions like the Piceance Basin, surface soil horizons are frequently depleted of their moisture supply by late summer. Plants dependent upon surficial moisture must therefore be adapted to periodic drought, either by producing seed before the droughts (spring ephemerals) or by becoming dormant during the drought period (as in perennial grasses). This trend is most pronounced at the lower drier elevations of the Piceance Basin. For example, in the pinyon-juniper type on Tract C-a, the number of herbaceous species encountered was reduced from 39 species in July to 32 species in September. This differential was even more pronounced within the lower elevational range of the sagebrush type with a reduction from 60 herbaceous species in July to 30 species in September.

Soils tend to be geologically very young in the Piceance Basin and in some instances, plant distribution may be almost entirely dictated by the chemical

nature of parent materials. For example, the desert-shrub (shadscale) vegetation type in the study area is almost entirely restricted to the light-colored geologic strata which frequently outcrop on south slopes. Chemical analyses to be performed on soil samples from these outcrops will likely reveal a definite saline-sodic chemical character imparted to the sedimentary parent materials by their environment of deposition. Thus, even if surface soils contain an appreciable amount of moisture, soil chemistry may make the water physiologically unavailable to all but those few species specifically adapted to such conditions.

In the pinyon-juniper vegetation type, which covers about 70% of the approximately 160 sq mi study area, differences in elevation and soil parent material effect considerable variation in species composition. The shallow, well-drained soils of the Rentsac Series are common to the pinyon-juniper woodland in the study area. These soils have been formed in residuum from sandstone and consist of gravelly sandy loam which provides for rapid moisture infiltration. Pinyon-juniper woodland at lower elevations (below 2,100 m, 7,000 ft) is generally underlain by dry, poorly developed aridisols (Ward, Slauson and Dix, 1974). At these lower elevations, where the parent material is composed largely of shales, Utah juniper may be the only tree present, and the scattered understory consists of stunted individuals of beardless wheatgrass, junegrass, needle-and-thread and Indian ricegrass (Ward, Slauson and Dix, 1974). Where sandstone composes the bulk of the parent material, Utah juniper may be joined by pinyon pine, but Utah juniper remains dominant. Big sagebrush, junegrass, western wheatgrass, needle-and-thread and Indian ricegrass commonly comprise the understory at these sites. Soil profiles are better developed and plant productivity is usually higher here than on sites where shale forms the parent material (Ward, Slauson and Dix, 1974).

Pinyon pine becomes dominant within higher elevation pinyon-juniper woodlands. (above 2,100 m, 7,000 ft) where the soils are usually well developed mollisols. The species composition and productivity of the understory is not so dependent on the soil parent materials at these higher elevation pinyon-juniper sites

as is the case at lower elevations, possibly because of higher average annual precipitation at higher sites. Big sagebrush usually dominates the understory, but some serviceberry, chokecherry and mountain mahogany may also be present.

Much of the sagebrush vegetation type occupying bottomlands and valleys on and near Tract C-a is underlain by soils of the Glendive Series which are deep, well-drained and consist of fine sandy loam. Big sagebrush has a complex root system consisting of a long tap root with numerous lateral branches. This allows the plant to utilize moisture at a considerable depth as well as at the surface of the soil (Fautin, 1946). These plants attain their greatest size in bottomland areas in the vicinity of Tract C-a where sufficient soil moisture is available at a depth of 3-6 ft and where the salt content of the soil is very low.

Big sagebrush is sometimes found in association with greasewood in places where there is some salinity present in the subsoil (Ward, Slauson and Dix, 1974). But where big sagebrush does intergrade with greasewood in the vicinity of Tract C-a, it is normally found only along bottoms where the soil is deeper, more permeable and better drained than on adjacent slopes. Rabbitbrush commonly invades and dominates big sagebrush sites in the study area that have been disturbed by burning or cultivation (Young and Evans, 1974). Several wheatgrass species in addition to Indian ricegrass are common understory species in the bottomland sagebrush vegetation type.

The sagebrush vegetation type occupying upland sites, (slopes and ridgetops) is underlain by soils of the Rentsac-Piceance Series. These soils are moderately deep, well drained and are composed of sandy loam to gravelly, sandy loam. Big sagebrush at these sites is much smaller in size than at bottomland sites probably because bottomland sites receive direct precipitation and runoff from adjacent slopes, as well as winter accumulations of drifted snow. Windswept ridgetops and mesas receive the least moisture, particularly at lower elevations such as 84 Mesa where a low-growing, stunted sagebrush community exists. Typical understory species at upland

big sagebrush sites include junegrass, wheatgrass and needle-and-thread.

In summary, within the overlapping elevational ranges of pinyon-juniper and sagebrush vegetation types of the study area, the two types are segregated by the differing abilities of dominant species to compete with each other under differing physical-chemical soil conditions. Within the elevational range of the two types there is a tendancy for big sagebrush to occupy the valleys, mesas or gentle slopes where fine-textured soils are prevalent. The pinyon-juniper type occupies the ridges, canyons or steep slopes where coarse, rocky soils predominate. On soils intermediate in texture and depth there is a great deal of competition between big sagebrush, pinyon pine and Utah juniper.

The second set of influences affecting soil moisture availability is that of macro- and microclimate. Microclimatic conditions, as they affect soil moisture, are largely controlled by elevation, the direction of slope relative to the location of the sun (aspect), slope steepness and prevailing winds. Briefly, increases in elevation correlate with increases in precipitation and lower evaporation rates (due to cooler temperatures). In these northern latitudes the sun is always to the south. Therefore, south slopes receive the greatest amount of insolation, creating the most rapid rates of evaporation, particularly in the hot afternoon (southwest slopes) and on steeper slopes. This relationship is even more pronounced in the Tract C-a vicinity because prevailing winds during the growing season are also from the southwest (Chapter 6). Thus, soil moisture depletion by evaporation and by transpiration from plants is much greater on southwest than on northeast slopes, and this is a predominant influence upon vegetation distribution in the area. Precipitation variability, as well as quantity and seasonal distribution, exert an important influence on vegetation of the Tract C-a area. The drier years effectively determine the dominant perennial vegetation which must be capable of surviving the variations of climate. During periods of above average precipitation, several minor species may become very abundant (especially annuals since they have a short life cycle and high seed pro-

duction), and overall vetetation cover may increase substantially. In fact, seeds of many species in semi-arid regions will not germinate except in years that are wetter than normal. Populations of such species, however, are rapidly reduced by one or two drought years.

Of course, not quite all abiotic factors influencing the distribution of vegetation in the Tract C-a area can be discussed as controlling factors operating through their effect upon soil moisture availability. For example, fire may radically alter plant distribution patterns. Fires in the pinyon-juniper type may destroy the trees and encourage a dramatic increase in cover by sagebrush and perennial grasses. About 45 years following a fire the trees gradually take over from sagebrush and perennial grasses (Frischknecht, 1975). Fire and mechanical removal of sagebrush at a number of locations on and near Tract C-a, have obviously allowed rabbitbrush communities to take over in areas previously occupied by big sagebrush. Big sagebrush does not sprout when stands are destroyed in wildfire. However, rabbitbrush, which is a seral dominant in many big sagebrush communities, sprouts profusely after the fires destroy aerial portions of the sagebrush plants (Young and Evans, 1974).

In the final analysis, although factors controlling the distribution of vegetation in arid regions are more readily evaluated than those in more humid areas, local plant communities and ecosystems are still highly variable. "Early attempts to explain distribution, composition, successional changes and management responses in terms of single factors were overly simplistic. These variations can be better explained in terms of a complex of environmental patterns, historical events, and successional mechanisms" (West, Rea, and Tausch, 1975). On Tract C-a the ordination of vegetation with elevation, slope and aspect in the pinyon-juniper type was similar to that found by West, et al. (1975, see page 3-7-109 for a more complete discussion). Also in the mixed brush type at Tract C-a there was an increase in cover with increasing elevation and a response to differences in slope and aspect (Figure 3-7- 82). However, the serviceberry-snowberry association of the

mixed brush type showed much more variability in cover than did the serviceberry-Gambel oak association. This illustrates that although much of the patterning of vegetation at Tract C-a is attributable to variations in soil moisture (as affected by elevation, slope and aspect) the biotic and physical environmental factors are importantly affecting vegetation distribution on a micro-scale.

C. Producer - Primary Consumer Interactions - Given the above outline of how physical/environmental factors may influence vegetation distribution in the Tract C-a area, we may turn attention to how vegetation distribution, in turn, influences the animals (primary consumers) which depend upon the vegetation as a primary source of food and shelter. Conversely, if animal numbers become large they may influence the distribution and vigor of the plants upon which they depend. Although the relative impact of different consumer groups upon vegetation may vary with time and from one locality to another, there is a general pattern which may be applied. The following discussion treats the primary consumers of Tract C-a in the order of their potential (from highest to lowest) for affecting the plants (producers) upon which they depend.

In general, herbivorous insects have the greatest potential for consuming their plant hosts to a degree which could affect plant vigor and distribution.

Aphids, thrips, checker beetles and ants are the most important herbivorous insects found within the pinyon-juniper and sagebrush vegetation types on the study area. These insect groups are either plant tissue or plant sap feeders (aphids and ants), flower feeders (thrips and checker beetles) or seed feeders (ants) and in their feeding habits can often cause moderate to severe damage to their food species.

Ants are probably the most numerous insect group encountered in both the sagebrush and pinyon-juniper vegetation types. They are primarily seed eaters and where their numbers are large they gather and consume vast quantities of seeds. Ants have been frequently observed accompanying and attending aphids in both sagebrush and pinyon-juniper vegetation types. The aphids feed on plant sap (sagebrush, rabbitbrush and others) and the ants are instrumental in moving the aphids to unconsumed portions of the food plant and in protecting them from predators. The ants in return feed on the waste products of the aphids. Ants, through their burrowing activities, often play an important role in the aeration and loosening of these arid soils. They also perform other important arid soil formation activities that are similar to those credited to the earthworm in more moist areas (Fautin, 1946).

Pinyon and juniper in the study area both support heavy populations of Miridae (leaf feeding insects). In addition, several species of wood-boring beetles have been identified on pinyon pine. Frischknecht (1975) reported that grasshoppers (also common in the study area) feed on the surface of juniper berries, causing them to wither, crack open and fall to the ground. Keen (1973) reported that insects can destroy as much as 90% of the pinyon pine cone crop when infestations are heavy. Although many herbivorous insects are often regarded as pests, they do play a vital role in the food web of local pinyon-juniper and sagebrush ecosystems by providing an important food source for lizards, birds and insectivorous mammals such as shrews and bats.

The second consumer group, in order of potential for utilizing plant resources, is that of the ungulate large mammals. This group includes domestic livestock, feral horses, elk and mule deer. Presently, the most

significant producer-ungulate consumer interaction is that between pinyon-juniper/sagebrush vegetation types and domestic livestock. Man's introduction of unrestricted grazing by domestic livestock a little more than a century ago filled a large-herbivore ecological niche that had been relatively unexploited since the close of the Pleistocene. This greatly altered plant succession in the Great Basin (Young and Evans, 1974) and led to reduced herbaceous competition and increased dispersion of seeds in animal feces. Primarily for this reason the pinyon-juniper type has so extended its range that much of the present pinyon-juniper is a recent phenomenon. "The trees have invaded what was formerly savannah, grassland or shrub steppes; both upslope and down . . . Simultaneous with the invasion of new areas was the substantial increase in tree density within stands in existence over 100 years ago. The trees have replaced formerly more abundant shrub and herbaceous understory" (West, et al., 1975). Even with the encroachment of pinyon-juniper onto adjacent rangelands and the reduction in herbaceous understory, range managers commonly regard pinyon-juniper as the most valuable vegetation type for livestock production west of the 100th meridian (Dwyer, 1975). This vegetation type is often chained to remove the overstory, thereby increasing production of forage species and increasing its value as cattle range.

Most cattle in the vicinity of Tract C-a are herded onto higher elevations through the warm months but then are concentrated in lower elevation meadows where they are fed hay throughout the winter. Range analysis performed over these Bureau of Land Management grazing allotments in the Tract C-a area revealed local ranges to be in a generally moderate condition even though local ranchers identified range conditions as being better in the 1975 season than at any time in recent years. A breakdown of the range analyses into contributing components (such as soil condition, plant vigor, and browse condition) reveals that most components were low or in a downward trend but were overbalanced by unexpectedly high numbers of desirable forage species (Section 7.1.C, Range Analysis). A widespread downward trend for surface soil conditions and a much lower rate of forage production than was expected

by Soil Conservation Service standards (Section 7.1.D, Range Production-Utilization) are other indicators, both of which suggest a long-term decline in the capacity of Tract C-a rangeland to support current levels of ungulates. It is of interest, in this respect, that two of the three BLM grazing allotments in the study area were stocked last year at rates exceeding those recommended by the agency (Section 7.2.F, Domestic Livestock); further, that there has been a proliferation of feral horses since the 1971 Wild Horse and Burro Act with no concurrent effort to reduce livestock numbers.

The general observation of younger juniper trees at the forest edge and juniper saplings and seedlings extending well out into adjacent vegetation types lend credence to the view that here, as elsewhere throughout the Great Basin province, the pinyon-juniper type is extending its range at the expense of adjacent vegetation types which are potentially more productive.

Mule deer show seasonal preferences with regard to forage utilization but they consume primarily browse, or shrubby forage throughout much of the year and depend almost exclusively on browse during the winter months. Since mule deer are primarily browsers, they seldom do serious damage to the vegetation. In fact, to a certain degree their browsing can stimulate some shrub species (e.g., serviceberry, Gambel oak) to increase production of twigs (Shepherd, 1971; Hill, 1956). However, excessive browsing (i.e., over 60% utilization of the shrub) which often results from overcrowding of mule deer can kill or reduce the browse species.

Browse conditions in the Tract C-a study area were overwhelmingly in the "good" condition class. The largest portion, however, was seen to exhibit downward trend or a deterioration in condition (Section 7.1.C, Range Analysis). Mule deer use the study area primarily during the transitions between winter and summer range, except in mild winters (Section 7.2.B, Large Mammals). This, and the fact that mule deer which utilize the area for winter and transitional

ranges have decreased drastically in numbers since the 1950's, may account for the favorable condition of browse which prevails. The evidence that this favorable condition is deteriorating may correspond with increasing numbers of feral horses which may utilize browse species heavily when snow depths prevent access to preferred herbaceous species.

Mule deer may play an important role in the structure of pinyon-juniper stands east of Tract C-a. Hansen and Dearden (1975) pointed out that during severe winters a large percentage of the mule deer's diet consists of pinyon pine and that juniper is also an important dietary item for this species. In dense pinyon-juniper stands, the cropping back of the saplings and seedlings of these two tree species by mule deer when other, more preferred, browse species are not available can result in thinning of the forest. As the older trees die out there are no younger trees to take their place. When a dense forest is thinned, a greater amount of solar energy is allowed to reach the forest floor resulting in a proliferation of the herbaceous and shrub strata.

Where chaining or burning has been used to remove pinyon and juniper trees in favor of preferred forage and browse species, browsing pressure may help to prevent the trees from regaining dominance (Stephens, Giunta, and Plummer, 1975).

Although pinyon and juniper are advancing throughout the Tract C-a area, the high-lined trees and stunted (frequently killed) saplings and seedlings at the forest border are ample evidence that this advancement is being retarded by browsing. East of Tract C-a, at the edge of the winter range for a portion of the Piceance Basin mule deer herd, large numbers of mule deer may concentrate on stands of pinyon-juniper and sagebrush vegetation. For example, observations last winter on lower elevational zones east of Tract C-a indicated heavy mule deer utilization of serviceberry, where pinyon-juniper and sagebrush types intergrade. In each area the deer can find both the greatest vareity of browse species (pinyon-juniper, sagebrush, serviceberry, bitterbrush and mountain mahogany) and at the same time take advantage of the cover and

protection from cold and wind afforded by pinyon and juniper trees. Aerial census results indicate that deer avoid large, open areas of sagebrush during the cold months even though these areas would provide considerable browse.

Feral horses are numerous (herds up to 30 individuals have been observed) west and southwest of Tract C-a and on 84 Mesa throughout the year. In these areas the feral horses consume considerable amounts of herbaceous vegetation during the summer months and browse and herbaceous vegetation during the winter. Feral horses are observed on windblown ridges where they forage uncovered grasses during winter but they also frequent the pinyon-juniper forests. It is assumed that even though these forests probably do not provide all of the preferred dietary items for feral horses, they are used extensively for cover and as warm places out of the wind to bed down. Feral horses are much more mobile (because of their large size) in deep snow than are mule deer and are therefore able to travel greater distances from a bedding area in a pinyon-juniper stand to open areas which provide suitable forage. In areas where mule deer and horses occur together in the Tract C-a vicinity, the feral horses will often clear paths through the snow which are used by the mule deer in their search for palatable forage. Feral horses in their movement through a dense pinyon-juniper forest often break loose high branches which fall to the ground to become forage for animals such as mule deer and others.

Elk have been infrequently observed in the area of Tract C-a and probably only occur there in very small numbers, exerting very little influence on the native vegetation.

No ungulate species (elk, mule deer, feral horses or domestic livestock) can be considered an obligate browser or grazer. Rather, each tends to be opportunistic, relying on the most palatable or nutritious forage available at a given time of the year. Mule deer which have been described primarily as browsers, for example, rely heavily on browse during colder months when grasses lose much of their nutritive value and become buried under the snow. However, when fresh herbaceous vegetation becomes available in the spring

and early summer, the mule deer will feed heavily on it. Feral horses, which are categorized primarily as grazers, will utilize herbaceous material (grasses, forbs, and sedges) to a large extent during the warm months. During winter they continue to utilize herbaceous material and have been observed both pawing the snow to uncover palatable grasses and foraging on windblown ridgetops where the snow cover is gone and where utilizable herbaceous material is available. Feral horses do, however, become increasingly dependent on woody vegetation during the colder months when less herbaceous vegetation is available for consumption.

Small and medium-sized herbivorous mammals and birds may be combined in a common category representing the third and least likely consumer group to affect the vigor and distribution of vegetation upon which they feed. Nonetheless, herbivorous small mammals and birds, as primary consumers, often play a vital role in the distribution of certain plant species that they feed upon. Frischknecht (1975) stated that seed dispersal by birds and mammals is perhaps the most important mutualistic effect of pinyon-juniper faunal/vegetation relationships. This is probably also true for the sagebrush ecosystem. Both juniper and pinyon seeds, for example, can be carried long distances from their source both in the cheek pouches of small mammals such as chipmunks or in the feces of animals such as cottontail rabbits or pinyon jays and others. It has been speculated that some seeds passed by animals germinate more readily than others and also that some seeds remain viable for longer periods of time after passing through the digestive systems of certain animals (Johnsen, 1962). Parker (1945) attributed invasion of certain grassland areas by juniper to distribution of seeds by animals.

Several herbivorous small mammal (e.g., piñon mouse, Colorado chipmunk, bushy-tailed woodrat) and bird (e.g., pinyon jay) species are found almost exclusively within the pinyon-juniper vegetation type in the study area. All species appear to be associated with the pinyon-juniper vegetation type in the study area by their food and nesting requirements. Piñon mice, pinyon jays and Colorado chipmunks depend directly on pinyon and juniper for both food

(they feed on pinyon nuts and juniper berries) and nesting material. Woodrats nest in juniper stumps and in the many rock outcroppings prevalent in this vegetation type throughout the study area. They also depend heavily on pinyon nuts and juniper berries as a food source.

Data collected during live-trapping operations from over 2,700 individuals, comprising 13 small mammal species, have permitted the formulation of several generalizations concerning the distribution and abundance of small mammal populations among major habitats within the area of investigation at Tract C-a during the October, 1974 to October, 1975 sampling period (Section 7.2.A, Small Mammals). Within habitats sampled below 8,000 ft elevation, the amount of shrub cover appears to be the most important factor regulating the abundance of small mammals. The largest number of small mammals captured per unit trapping effort (i.e., individuals/100 traps) occurred on grid 3 (rabbitbrush), followed in order by grid A (greasewood-sagebrush) and grid 5 (mixed brush). Vegetation data collected from permanent phytosociological transects on or near small mammal grids showed that these grids also exhibited the highest shrub cover of all grids below 8,000 ft (Table 3-7-82). Accordingly, the grid with the fewest captures below 8,000 ft, grid 1 (bottomland meadow), also exhibited the lowest shrub cover.

Although the same trend holds true for grids above 8,000 ft, i.e., more small mammals are encountered in habitats with a higher shrub cover, total small mammal abundance is lower for these grids than for those at lower elevations. This is likely due to the harsher conditions and shorter growing season at the higher elevation.

Species diversity, as indicated by the Shannon-Weiner index which accounts for both number of species and number of individuals of each species, seems to be tied closely to the presence or absence of trees (i.e., pinyon-juniper) in habitats below 8,000 ft. Pinyon and juniper trees provide food for many small mammal species that eat the highly nutritious pinyon nuts and juniper berries. The latter are more consistently available than pinyon nuts as

they remain on trees a large part of the year and are not so completely destroyed by insects as pinyon nuts (Frischknecht, 1975). The cambium of pinyon may also be eaten by certain species such as porcupines and the shreddy bark of juniper is often used in nest building (Frischknecht, 1975).

The value of pinyon and juniper trees as a source of food and potential nesting sites is further emphasized when it is noted that eight of the thirteen species encountered during all live-trapping operations inhabited pinyon-juniper woodlands. In fact, three of the species, pinon mouse, Colorado chipmunk, and the bushy-tailed woodrat were generally limited to this vegetation type.

At elevations above 8,000 ft the harshness of the environment is probably a more important determining factor in the distribution of small mammals than the presence or absence of trees. Of the 13 species encountered, only 5 were captured in grids established at the higher elevations. Furthermore, only one trappable small mammal species, the red-backed vole, is specifically adapted to the environmental extremes of the higher altitudes (Lechleitner, 1969).

The two most abundant small mammal species in the vicinity of Tract C-a are the least chipmunk and the deer mouse. Both were represented in samples from every grid and together accounted for 82.4% of the total small mammal abundance. The habitat affinities of the least chipmunk and the deer mouse are almost identical, since both species were caught more frequently in

Of the three most common species collected by removal trapping for analyses of stomach contents, two, the least chipmunk and the deer mouse, indicated preferences for seeds. However, both utilized succulent materials more frequently in the spring when new seeds were not yet abundant. The deer mouse was slightly more omnivorous in its food habits as evidenced by the invertebrate and vertebrate materials occasionally observed in stomach contents. Long-

tailed voles, collected in the aspen vegetation type, primarily utilized succulent materials. However, it too was opportunistic when its favored food was not available: a high percentage of seeds were found in stomachs of specimens collected in early spring.

Porcupines may have a special and, in restricted areas used as "yards" in winter, severe effect upon pinyon pine distribution. Much porcupine damage to pinyon pine has been observed in the area of Tract C-a. Porcupines show a preference for the bark and cambium layers of pinyon pine trees and in their feeding, often girdle (remove all bark and cambium in a 360^{0} circle around the tree) the tree and in so doing, cause it to die.

Bird species which are predominantly herbivorous and characteristic of the study area include the sage grouse and pinyon jay. Sage grouse are important inhabitants of the sagebrush and mixed brush vegetation types in the study area. They depend heavily on big sagebrush for food and nesting sites. Large open areas prevalent within many sagebrush sites, serve as displaying ground (leks) during the breeding season. Sage grouse frequently retreat to the denser stands of sagebrush on the study area where they roost, feed and seek shelter. The pinyon jay is an extremely gregarious bird. Individual flocks may commonly return to a traditional breeding ground year after year to nest and rear their young (Frischknecht, 1975). Then in late summer, they may congregate again in the same area to gather and cache pinyon nuts, indicating a strong reliance upon pinyon nuts during their reporductive season the follwoing spring (Balda and Bateman, 1971).

D. <u>Primary Consumer-Secondary and Higher Order Consumer Interactions</u> - Th most diverse and populous group fo these higher order consumers is the invertebrate group, including insects, spiders, and centipedes. Several species of insects are carnivorous in larval stages and herbiverous as adults.

Mammalian predators include the shrews and bats, which feed primarily on insects, and the coyotes, bobcats, weasels and badgers which mainly eat birds, mice, rabbits and ground squirrels. Coyotes and weasels (longtail weasel and ermine) appear to be the most common mammalian predators in the vicinity of Tract C-a (Section 7.2.C, Mammalian Predators). Both species range throughout the pinyon-juniper and sagebrush vegetation types where they feed on small mammals, birds, birds' eggs and carrion. Coyote food habit studies cited by Fautin (1946) indicate that this species feeds upon all types of rodents, birds, reptiles, insects and even some vegetable matter. Sperry (1941) reported that rabbits occurred in 43% of the 8,339 coyote stomachs he examined. Seasonal rodent abundance probably plays an important part in coyote dietary habits in the study area. Lagomorph studies indicate that rabbits are not presently abundant and therefore probably do not play an important role in the coyotes' diet at this time. Although dietary information for the coyote has not been gathered in the study area, it can be assumed that when rodents, such as ground squirrels and chipmunks, become abundant during the warm months, they are probably fed upon extensively by the coyotes. During the winter period, however, when these rodents are inactive, the coyote probably resorts to feeding heavily on carrion provided in abundance during some winters by natural mule deer mortality in the study area. Rasmussen (1941) examined coyote scat collected during mid-winter from a pinyon-juniper ecosystem in northern Arizona. He found the scat to consist mainly of deer hair and bones, some rabbit fur and the remains of deer mice. He found both mule deer carrion that had been fed upon by coyotes and fresh mule deer that had been killed and eaten by coyotes. Coyote scat that was collected during summer from the same area by Rasmussen (1941) consisted primarily of juniper berries, serviceberries, prickly pears, grass and rodent remains. Signs of bobcat and badger have also been recorded in the study area but these species do not appear to be common and therefore probably exert little influence on local prey populations.

Insectivorous mammals such as shrews and bats have not been recorded in large numbers in Tract C-a vicinity pinyon-juniper and sagebrush ecosystems.

Bats have been captured in mist nets near the few isolated pockets of open water in the study area where they regularly feed on airborne insects at dusk during the summer months. Bats probably roost by day in the rock outcroppings and rock crevices prevalent throughout the pinyon-juniper vegetation type in the study area. Bats have been known to consume large quantities of insects in certain areas where their populations are large and in certain parts of the country, they have been credited with controlling the numbers of potential pest insects. Shrews also feed voraciously on insects but this order of small mammals has not been recorded regularly for Tract C-a sagebrush and pinyon-juniper ecosystems. Shrews by nature are elusive and very difficult to capture by conventional live-trapping techniques. Since so few have been captured in the study area to date, it is diffucult to speculate on their importance in local ecosystems.

Avian predators like the common flicker, the white-breasted nuthatch and the blue-gray gnatcatcher primarily (insectivores) consume large quantities of insects. The predatory hawks, owls, falcons and eagles prey on small mammals and birds and help to limit the populations of these animals. The ravens are generally scavengers but have been known to take live prey, particularly small mammals and birds.

Golden eagles, great horned owls, kestrels and ravens are the most important year-round avian predators in the study area (Section 7.2.D, Avifauna). Red-tailed hawks are common during the warm months in the study area, but their numbers dwindle with the onset of winter. Rough-legged hawks are common on the study area only during winter.

Golden eagles range throughout the entire study area during all seasons. They are opportunistic in their feeding habits and their diet in the region of the Piceance Basin ranges from mule deer carrion in the winter to rodents such as ground squirrels during summer (ECI, 1975). In other areas, golden eagles have been known to feed heavily on rabbits when this group is abundant.

Great horned owls are found throughout the pinyon-juniper and sagebrush vegetation types on the study area during all seasons of the year. They seem to prefer nesting along rock cliffs and outcroppings prevalent along washes and gulches throughout the pinyon-juniper ecosystem. Owl pellet studies south of Tract C-a (ECI, 1975) indicate that the great horned owl in this area of the Piceance Basin feeds almost exclusively on microtine rodents (voles) throughout the year.

Kestrels are common throughout the pinyon-juniper and sagebrush ecosystems year-round, although their numbers in the study area dwindle during winter. Kestrels feed more heavily on insects during the warm months, except during the period when they rear young. At that time, kestrels feed more heavily on small mammals as a food source probably because of the greater energy demands placed upon them by their young. During fall, kestrels have been observed consuming large quantities of grasshoppers in the study area.

Ravens are common scavengers found throughout the study area all year. They have been observed feeding both on dead cattle and mule deer during winter. Pellet studies indicated that ravens in this region of the Piceance Basin also feed on small mammals and birds. Both red-tailed and rough-legged hawks range throughout the region where they feed upon a wide variety of rodents, including deer mice, voles, ground squirrels and chipmunks (Ecology Consultants, Inc., 1975).

Sagebrush and short-horned lizards are the most common predaceous reptiles in the study area. They have been recorded in abundance in pinyon-juniper stands where deadfall and rock outcroppings provide adequate cover. Both reptile species are insectivorous and are only active during the warm months. Marcellini and Mackey (1970) demonstrated quantitatively that the sagebrush lizard is primarily a ground dweller in the western part of its range. Turner (1974) in a study in western Colorado, observed the sagebrush lizard on the ground 57% of the time. Turner (1974) also found that ants (Formicidae) accounted for 59% of the lizard diet while beetles (Coleoptera),

caterpillars (Lepidoptera), bugs (Hemiptera) and larvae were also important food items.

E. General Discussion of Terrestrial Interactions - It should be emphasized as was pointed out at the beginning of this discussion, that terrestrial ecological interactions are far more varied and complicated than is implied in the simplified treatment above. Many species commonly associated with given trophic levels are more properly classified as omnivores. This group includes the shrews, coyotes, mice, ravens, mountain bluebirds and green-tailed towhees. A good example of omnivory is exhibited in the food habits of coyotes. As previously stated, they consume vegetable matter as well as insects, mice, eggs, young birds and carrion. A diversified diet allows an animal to be opportunistic in its forays for food and relatively independent of the availability of single food items.

Other kinds of interactions could be discussed in addition to those above. One could discuss producer-producer interactions. The proliferation and expansion of the pinyon-juniper tree stratum, (which can result when increasing livestock grazing pressure or fire reduces the competition for water and minerals normally exerted by the herbaceous and shrub strata) can also have profound effects on the composition and density of the herbaceous and shrub strata. As the tree canopy becomes more closed, it not only reduces the amount of solar energy reaching the forest floor, but it also produces greater accumulations of litter. This has been the prevailing, recent pattern in pinyon-juniper forests (West, et al., 1975). Jameson (1970) has indicated that toxic substances (phenolic compounds) in the scales of juniper can have an inhibitory effect on grass growth. These same phenolic compounds exuded by juniper scales may also inhibit the natural processes of decomposition (by their effects on the bacteria) essential for nutrient cycling (Jameson, 1970).

There are also important interactions involving the direct influence of physical environmental factors upon primary consumers. Invertebrate groups having the greatest potential for negatively influencing their plant hosts

seldom do so except under infrequent climatic regimes which favor maximum population growth. Results of 1975 big game studies around Tract C-a indicated maximum deer concentrations in the lesser shrub and pinyon-juniper communities on north slopes. However, in severe winters (those most critical to big game population density) deep snows on north slopes force the deer to utilize the less favorable southwest slopes which are cleared sooner by more direct sunlight and prevailing winds. Thus, the most critical factor limiting the growth of big game herds is apt to be the extent and quality of winter range on southwestern slopes. Finally, many animal species depend to some degree on the availability of drinking water. Thus, the effect of mine dewatering upon the few seeps and springs in the Tract C-a vicinity will be an item of concern in oil shale development (Weeks, et al., 1974).

Physical environmental factors may directly affect secondary consumers as well. For example, eagles may be highly opportunistic in the taking of prey and carrion. However, their requirements for suitable nest sites are highly specific. Thus, eagle populations may depend more upon the availability of suitable, remote cliff sites than upon food supplies.

Although decomposer groups have not been included in current studies because of the inadequacy of available field techniques, the activity is of primary importance to overall ecosystem functioning. By far, the greatest proportion of the annual production of non-crop vegetation in the study area falls to the ground as leaf or grass litter. Much of this is broken down by decomposers such as fungi, bacteria and soil arthropods. Insect groups such as Collembola, Diplura, Psocoptera, Acari and Thysanura, which are found in abundance at many pinyon-juniper and sagebrush sites in the study area, are all soil-litter inhabiting scavengers, and therefore play a vital role in breaking down detritus (non-living plant and animal matter). Any interference with these groups, and therefore with the recycling of nutrients back into terrestrial ecosystems, will have repercussions throughout local food webs.

A habitat type of special importance because of its limited distribution in the Tract C-a area is riparian habitat. Locally rare species, including

amphibians such as the chorus frog and tiger salamander, use the water, among other things, for protection against mammalian and avian predators. Great blue herons feed on aquatic vertebrates and many ducks feed on aquatic plant and animal life.

Tree, cliff and violet-green swallows feed heavily on the many insects that swarm over the few water impoundments in the study area. Killdeer, yellow-legs and sandpipers, observed at study area impoundments, feed on submerged aquatic invertebrates as well as some aquatic vegetation.

Finally, the influence of man on all trophic levels cannot be underestimated as an important factor affecting local ecosystems. He exports a large amount of the local green biomass production through livestock grazing, thus removing both energy and nutrients from local food webs and nutrient cycles. As a predator, man takes commerically important game species (such as rabbits, mule deer, sage grouse and waterfowl). Control of "pest" species, such as the coyote can have drastic effects upon local ecosystems. Attempts to remove a major element of local ecosystems, particularly a top level carnivore, are certain to change nearly all relationships among the remaining elements in ways that cannot presently be predicted. Man's influence cannot be extracted from consideration of local ecosystem interactions because man is a predominant herbivore and carnivore controlling much of the area's production, and at the same time introducing totally new influences into local environments.

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Appendix A. The following tables are summaries of vegetation data for the first-year environmental baseline programs. Data for herbaceous, shrub-seedling, and tree strata are presented with mean, standard deviation, and sample size for appropriate parameters. When mean values replace individual observations, the values are presented as mean of means, standard error, and number of means summarized (sample size, n).

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HERBACEOUS STRATUM-- ASPEN
SUMMARY-- 6 HERB TRANSECTS WITHIN TYPE-- ASPEN

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA (STD DEV, N)	**** DENSITY **** NO/HA (STD DEV,N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN (ST,DEV, N)	NUMBER /QUAD,	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
CAREX GEYERI	17,25	4,08	408,33 (325,05, 6)	ID (0, 2)	13,97	73,33 (32,66, 6)	ID	ID	100	31
BROMUS MARGINATUS	6,27	1,48	148,33 (179,49, 6)	ID (0, 2)	8,25	43,33 (27,33, 6)	ID	ID	100	15
VALERIANA OCCIDENTALIS	5,42	1,28	128,33 (104,39, 6)	36000 (8485, 2)	5,40	28,33 (13,29, 6)	1,80	6,35	100	11
POTENTILLA QUINQUIFOLIA	,00	,00	,00 (ID ,)	ID (0, 2)	,32	1,67 (4,08, 6)	ID	ID	17	0
CRYPTANTHA SERICEA	,00	,00	,00 (ID ,)	ID (0, 2)	,32	1,67 (4,08, 6)	ID	ID	17	0
VIOLA PALLENS	3,80	,90	90,00 (220,45, 6)	70000 (98995, 2)	1,59	8,33 (13,29, 6)	3,50	42,00	33	5
THALICTRUM FENDLERI	2,89	,68	68,33 (66,46, 6)	18000 (11314, 2)	5,71	30,00 (20,98, 6)	,90	3,00	83	9
AGROPYRON TRACHYCAULUM	,32	,07	7,50 (18,37, 6)	ID (0, 2)	2,54	13,33 (32,66, 6)	ID	ID	17	3
U1A3	,07	,02	1,67 (4,08, 6)	ID (0, 2)	1,27	6,67 (16,33, 6)	ID	ID	17	1
SMILACINA SP,	,00	,00	,00 (ID ,)	ID (0, 2)	1,90	10,00 (24,49, 6)	ID	ID	17	2
ERIOGONUM SP,	,56	,13	13,33 (32,66, 6)	ID (0, 2)	,63	3,33 (8,16, 6)	ID	ID	17	1
MERTENSIA BREVISTYLA	,00	,00	,00 (ID ,)	ID (0, 2)	,63	3,33 (8,16, 6)	ID	ID	17	1
SENECIO SP,	,14	,03	3,33 (8,16, 6)	ID (0, 2)	,63	3,33 (8,16, 6)	ID	ID	17	1
ACHILLEA LANULOSA	,42	,10	10,00 (12,65, 6)	6000 (8485, 2)	2,22	11,67 (11,69, 6)	,30	2,57	67	3
CIRSIUM SP,	,00	,00	,00 (ID ,)	ID (0, 2)	,32	1,67 (4,08, 6)	ID	ID	17	0
CHENOPODIUM LEPTOPHYLLUM	,21	,05	5,00 (8,37, 6)	4000 (5657, 2)	,63	3,33 (5,16, 6)	,20	6,00	33	1
GALIUM BOREALE	6,55	1,55	155,00 (156,30, 6)	101000 (29698, 2)	10,79	56,67 (45,02, 6)	5,05	8,91	67	17
KOELERIA GRACILIS	,77	,18	18,33 (44,91, 6)	ID (0, 2)	,95	5,00 (12,25, 6)	ID	ID	17	2
HACKELIA FLORIBUNDA	,70	,17	16,67 (40,82, 6)	ID (0, 2)	,63	3,33 (8,16, 6)	ID	ID	17	1
SOLIDAGO SP,	3,24	,77	76,67 (187,79, 6)	ID (0, 2)	2,54	13,33 (32,66, 6)	ID	ID	17	6
VIOLA RUGALUSA	9,01	2,13	213,33 (522,56, 6)	ID (0, 2)	1,90	10,00 (24,49, 6)	ID	ID	17	11
CAREX VERNACULA	2,53	,60	60,00 (146,97, 6)	ID (0, 2)	2,54	13,33 (32,66, 6)	ID	ID	17	5
THERMOPSIS MONTANA	13,16	3,12	311,67 (302,55, 6)	70000 (25456, 2)	6,98	36,67 (31,41, 6)	3,50	9,55	67	20
GERANIUM RICHARDSONII	2,46	,58	58,33 (73,05, 6)	6000 (5657, 2)	3,49	18,33 (16,02, 6)	,30	1,64	67	6
AQUILEGIA CAERULEA	2,39	,57	56,67 (80,42, 6)	1000 (1414, 2)	,95	5,00 (5,48, 6)	,05	1,00	50	3
OSMORHIZA DEPAUPERATA	2,25	,53	53,33 (130,64, 6)	ID (0, 2)	,95	5,00 (12,25, 6)	ID	ID	17	3
POTENTILLA PULCHERRIMA	1,69	,40	40,00 (64,81, 6)	5000 (7071, 2)	,95	5,00 (8,37, 6)	,25	5,00	33	3
SMILACINA STELLATA	2,53	,60	60,00 (91,43, 6)	9000 (9899, 2)	3,17	16,67 (19,66, 6)	,45	2,70	67	6
COLLOMIA LINEARIS	,07	,02	1,67 (4,08, 6)	ID (0, 2)	,32	1,67 (4,08, 6)	ID	ID	17	0
TARAXACUM OFFICINALE	,28	,07	6,67 (12,11, 6)	3000 (4243, 2)	,63	3,33 (5,16, 6)	,15	4,50	33	1
OSMORHIZA DEPAUPERATA	7,39	1,75	175,00 (297,30, 6)	97000 (74953, 2)	7,94	41,67 (46,22, 6)	4,85	11,64	50	15
CLEMATIS COLUMBIANA	1,20	,28	28,33 (60,14, 6)	2000 (2828, 2)	1,27	6,67 (12,11, 6)	,10	1,50	33	2
HELIANTHELLA UNIFLORA	,07	,02	1,67 (4,08, 6)	ID (0, 2)	,32	1,67 (4,08, 6)	ID	ID	17	0
STIPA COLUMBIANA	1,55	,37	36,67 (56,80, 6)	ID (0, 2)	2,54	13,33 (21,60, 6)	ID	ID	33	4
CIRSIUM ARVENSE	,56	,13	13,33 (32,66, 6)	ID (0, 2)	,63	3,33 (8,16, 6)	ID	ID	17	1
LINUM KINGII	1,41	,33	33,33 (81,65, 6)	ID (0, 2)	,32	1,67 (4,08, 6)	ID	ID	17	2
HELIANTHELLA UNIFLORA	,84	,20	20,00 (40,00, 6)	29000 (9899, 2)	,63	3,33 (5,16, 6)	1,45	43,50	33	1
VIOLA NUTTALLII	,56	,13	13,33 (32,66, 6)	24000 (33941, 2)	,95	5,00 (12,25, 6)	1,20	24,00	17	2
SOLIDAGO MULTIRADIATA VAR, S	,92	,22	21,67 (53,07, 6)	7000 (9899, 2)	,63	3,33 (8,16, 6)	,35	10,50	17	2
ERIGERON SPECIOSUS	,14	,03	3,33 (8,16, 6)	3000 (4243, 2)	,63	3,33 (8,16, 6)	,15	4,50	17	1
CIRSIUM ARVENSE	,35	,08	8,33 (20,41, 6)	7000 (9899, 2)	,95	5,00 (12,25, 6)	,35	7,00	17	1
ALL SPECIES		23,67	2367,50	498000						

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS,
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA,
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- ASPEN
SUMMARY-- 5 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
POPULUS TREMULOIDES	12	6	14	32	9,29	80 (45, 5)	929,20 (867,97, 5)	837 (630, 5)	61,37 (18,95, 5)	80
PSEUDOTSUGA MENZIESII (T)	0	0	0	0	,00	0 (0, 5)	,00 (,00, 5)	0 (0, 5)	,00 (,00, 5)	0
ACER GLABRUM	6	1	8	14	4,39	44 (46, 5)	438,60 (603,01, 5)	103 (102, 5)	91,46 (66,16, 5)	60
ARTEMISIA FRIGIDA	1	0	2	4	1,11	12 (27, 5)	110,80 (247,76, 5)	23 (52, 5)	22,16 (22,16, 5)	20
ARTEMISIA TRIDENTATA	0	0	1	2	,00	8 (11, 5)	,00 (,00, 5)	13 (18, 5)	,00 (,00, 5)	40
PRUNUS VIRGINIANA	16	14	12	42	12,34	68 (39, 5)	1234,20 (780,73, 5)	1943 (1945, 5)	56,11 (10,96, 5)	80
QUERCUS GAMBELII	0	0	1	2	,31	8 (11, 5)	31,00 (69,32, 5)	7 (9, 5)	31,00 (31,00, 5)	40
PACHYSTIMA MYRSINITES	0	4	4	8	,21	20 (45, 5)	20,80 (46,51, 5)	623 (1394, 5)	1,39 (1,39, 5)	20
RIBES SP.	0	1	3	5	,26	16 (36, 5)	26,00 (58,14, 5)	190 (425, 5)	2,89 (2,89, 5)	20
AMELANCHIER UTAHENSIS	18	3	9	30	13,87	52 (50, 5)	1387,20 (2131,09, 5)	450 (618, 5)	83,96 (41,38, 5)	60
SYMPHORICARPOS OREOPHILUS	15	22	14	51	11,65	80 (45, 5)	1165,20 (539,71, 5)	3137 (2117, 5)	30,94 (6,49, 5)	80
AMELANCHIER ALNIFOLIA	24	10	7	41	18,81	40 (55, 5)	1880,60 (2627,81, 5)	1367 (1876, 5)	48,71 (29,89, 5)	40
ROSA WOODSII	5	23	14	43	3,78	80 (45, 5)	378,40 (524,70, 5)	3337 (4765, 5)	18,48 (6,04, 5)	80
RIBES CEREUM	1	3	4	8	1,11	20 (45, 5)	110,60 (247,31, 5)	400 (894, 5)	5,27 (5,27, 5)	20
RIBES INERME	2	12	4	19	1,34	24 (43, 5)	133,60 (298,74, 5)	1773 (3928, 5)	5,34 (5,34, 5)	40
ALL SPECIES					78,46		7846,20	14203		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

MATURE TREE STRATUM-- ASPEN
SUMMARY-- 5 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)
POPULUS TREMULOIDES	97	97	93	287	41,33	100 (0, 5)	4133,00 (991,67, 5)	623 (212, 5)
PSEUDOTSUGA MENZIESII (T)	3	3	7	13	1,10	8 (18, 5)	110,40 (246,86, 5)	17 (37, 5)
ALL SPECIES					42,43		4243,40	640

SPECIES	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	**************** BASAL AREA *************** RELATIVE	M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
POPULUS TREMULOIDES	276,06 (43,36, 5)	96	20,93 (14,87, 5)	286	100
PSEUDOTSUGA MENZIESII (T)	55,20 (55,20, 5)	4	,78 (1,74, 5)	14	20
ALL SPECIES			21,71		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND
(**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

HERBACEOUS STRATUM-- DOUGLAS FIR
SUMMARY-- 6 HERB TRANSECTS WITHIN TYPE-- DOUGLAS FIR

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA (STD DEV, N)	**** DENSITY **** NO/HA (STD DEV,N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN (ST.DEV, N)	NUMBER /QUAD.	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
CAREX GEYERI	58.93	8.99	899.17 (494.05, 6)	ID (0, 4)	35.22	93.33 (5.16, 6)	ID	ID	100	94
ACHILLEA LANULOSA	1.53	.23	23.33 (38.30, 6)	12000 (9798, 4)	3.14	8.33 (4.08, 6)	.60	7.20	83	5
MOLDAVICA PARVIFLORA	.55	.08	8.33 (13.29, 6)	500 (1000, 4)	1.89	5.00 (5.48, 6)	.02	.50	50	2
LITHOSPERMUM RUDERALE	1.09	.17	16.67 (26.58, 6)	1500 (1915, 4)	1.89	5.00 (5.48, 6)	.07	1.50	50	3
BROMUS SP.	.00	.00	.00 (ID ,)	ID (0, 4)	.63	1.67 (4.08, 6)	ID	ID	17	1
ASTRAGALUS TENELLUS	5.46	.83	83.33 (146.65, 6)	20500 (24352, 4)	8.18	21.67 (29.94, 6)	1.02	4.73	50	14
LINUM KINGII	2.84	.43	43.33 (106.14, 6)	ID (0, 4)	4.40	11.67 (28.58, 6)	ID	ID	17	7
VIOLA SP.	.11	.02	1.67 (4.08, 6)	1000 (2000, 4)	1.26	3.33 (5.16, 6)	.05	1.50	33	1
STIPA COLUMBIANA	.66	.10	10.00 (24.49, 6)	ID (0, 4)	1.89	5.00 (8.37, 6)	ID	ID	33	3
TARAXACUM OFFICINALE	.11	.02	1.67 (4.08, 6)	500 (1000, 4)	.63	1.67 (4.08, 6)	.02	1.50	17	1
HELIANTHELLA UNIFLORA	.22	.03	3.33 (8.16, 6)	15000 (30000, 4)	.63	1.67 (4.08, 6)	.75	45.00	17	1
THERMOPSIS MONTANA	.22	.03	3.33 (8.16, 6)	500 (1000, 4)	.63	1.67 (4.08, 6)	.02	1.50	17	1
THALICTRUM FENDLERI	10.05	1.53	153.33 (150.69, 6)	49000 (11832, 4)	5.03	13.33 (13.66, 6)	2.45	18.37	67	15
ERIGERON SPECIOSUS	2.40	.37	36.67 (62.50, 6)	17500 (24624, 4)	4.40	11.67 (13.29, 6)	.88	7.50	50	7
AGROPYRON TRACHYCAULUM	.76	.12	11.67 (18.35, 6)	ID (0, 4)	2.52	6.67 (12.11, 6)	ID	ID	33	3
GALIUM BOREALE	2.18	.33	33.33 (42.27, 6)	31000 (25639, 4)	6.29	16.67 (18.62, 6)	1.55	9.30	67	8
CREPIS ACUMINATA	.11	.02	1.67 (4.08, 6)	500 (1000, 4)	.63	1.67 (4.08, 6)	.02	1.50	17	1
AQUILEGIA CAERULEA	1.20	.18	18.33 (40.21, 6)	2000 (2828, 4)	1.26	3.33 (5.16, 6)	.10	3.00	33	2
KOELERIA GRACILIS	.11	.02	1.67 (4.08, 6)	ID (0, 4)	.63	1.67 (4.08, 6)	ID	ID	17	1
VIOLA ADUNCA	.98	.15	15.00 (36.74, 6)	4500 (9000, 4)	3.14	8.33 (20.41, 6)	.22	2.70	17	4
VICIA AMERICANA	2.73	.42	41.67 (88.19, 6)	11500 (19209, 4)	3.14	8.33 (16.02, 6)	.57	6.90	33	6
OSMORHIZA DEPAUPERATA	2.95	.45	45.00 (88.03, 6)	15500 (20809, 4)	3.77	10.00 (16.73, 6)	.77	7.75	33	7
SOLIDAGO SP.	2.40	.37	36.67 (89.81, 6)	12000 (24000, 4)	1.26	3.33 (8.16, 6)	.60	18.00	17	4
SMILACINA STELLATA	.66	.10	10.00 (16.73, 6)	1000 (1155, 4)	1.26	3.33 (5.16, 6)	.05	1.50	33	2
CHENOPODIUM FREMONTII	.66	.10	10.00 (24.49, 6)	5000 (10000, 4)	.63	1.67 (4.08, 6)	.25	15.00	17	1
BROMUS MARGINATUS	.33	.05	5.00 (8.37, 6)	ID (0, 4)	2.52	6.67 (10.33, 6)	ID	ID	33	3
STIPA COMATA	.11	.02	1.67 (4.08, 6)	ID (0, 4)	.63	1.67 (4.08, 6)	ID	ID	17	1
VIOLA NUTTALLII	.33	.05	5.00 (12.25, 6)	3500 (7000, 4)	1.26	3.33 (8.16, 6)	.17	5.25	17	2
VIOLA PALLENS	.33	.05	5.00 (12.25, 6)	2000 (4000, 4)	1.26	3.33 (8.16, 6)	.10	3.00	17	2
ALL SPECIES		15.26	1525.83	206500						

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS.
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA.
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- DOUGLAS FIR
SUMMARY-- 5 NON-PERM. TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
PSEUDOTSUGA MENZIESII (T)	14	14	17	45	7.77	100 (0, 5)	777.20 (622.19, 5)	1687 (745, 5)	69.19 (11.87, 5)	100
MAHONIA REPENS	0	0	1	2	.01	8 (18, 5)	1.00 (2.24, 5)	20 (45, 5)	1.00 (1.00, 5)	20
ACER GLABRUM	3	1	3	7	1.57	20 (35, 5)	157.20 (215.31, 5)	87 (159, 5)	42.11 (27.27, 5)	40
ARTEMISIA TRIDENTATA	0	0	1	1	.00	4 (9, 5)	.00 (.00, 5)	13 (30, 5)	.00 (.00, 5)	20
CERCOCARPUS MONTANUS	0	0	1	1	.00	8 (18, 5)	.00 (.00, 5)	10 (22, 5)	.00 (.00, 5)	20
CHRYSOTHAMNUS NAUSEOSUS	0	0	1	1	.08	4 (9, 5)	7.80 (17.44, 5)	3 (7, 5)	7.80 (7.80, 5)	20
CHRYSOTHAMNUS VISCIDIFLORUS	0	0	1	1	.02	4 (9, 5)	2.20 (4.92, 5)	13 (30, 5)	2.20 (2.20, 5)	20
PRUNUS VIRGINIANA	5	3	6	14	2.79	36 (50, 5)	279.00 (411.57, 5)	353 (538, 5)	21.80 (13.78, 5)	40
PURSHIA TRIDENTATA	1	0	1	1	.34	4 (9, 5)	34.00 (76.03, 5)	10 (22, 5)	34.00 (34.00, 5)	20
QUERCUS GAMBELII	4	6	6	15	2.18	32 (36, 5)	217.60 (260.29, 5)	690 (860, 5)	19.77 (9.13, 5)	60
PACHYSTIMA MYRSINITES	13	5	3	22	7.36	20 (45, 5)	736.00 (1645.75, 5)	663 (1483, 5)	21.65 (21.65, 5)	20
ROSA SP.	0	1	2	3	.04	12 (27, 5)	4.00 (8.94, 5)	110 (246, 5)	.67 (.67, 5)	20
AMELANCHIER UTAHENSIS	22	9	13	43	12.49	72 (44, 5)	1249.00 (925.48, 5)	1047 (1439, 5)	71.56 (25.40, 5)	80
SYMPHORICARPUS OREOPHILUS	20	38	17	75	11.20	100 (0, 5)	1119.80 (418.93, 5)	4597 (1846, 5)	27.49 (4.12, 5)	100
AMELANCHIER ALNIFOLIA	12	3	4	19	6.75	24 (43, 5)	675.20 (1509.79, 5)	310 (675, 5)	20.46 (20.46, 5)	40
HOLODISCUS DUMOSUS	0	0	2	3	.06	12 (27, 5)	5.60 (12.52, 5)	53 (119, 5)	5.60 (5.60, 5)	20
ROSA WOODSII	1	6	8	15	.64	48 (41, 5)	63.60 (114.43, 5)	703 (1155, 5)	9.61 (4.48, 5)	80
RIBES CEREUM	1	1	3	5	.42	20 (45, 5)	42.20 (94.36, 5)	70 (157, 5)	7.03 (7.03, 5)	20
RIBES INERME	3	5	3	12	1.71	20 (45, 5)	171.20 (382.81, 5)	623 (1394, 5)	3.57 (3.57, 5)	20
SAMBUCUS COERULEA	0	0	1	1	.00	8 (18, 5)	.00 (.00, 5)	7 (15, 5)	.00 (.00, 5)	20
ALL SPECIES					55.91		5591.20	12240		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

MATURE TREE STRATUM-- DOUGLAS FIR
SUMMARY-- 5 NON-PERM. TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)
POPULUS TREMULOIDES	1	1	4	6	.60	4 (9, 5)	60.00 (134.16, 5)	3 (7, 5)
PSEUDOTSUGA MENZIESII (T)	99	99	96	294	53.77	100 (0, 5)	5376.80 (2211.92, 5)	467 (69, 5)
ALL SPECIES					54.37		5436.80	470

SPECIES	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	**** BASAL AREA **** RELATIVE	M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
POPULUS TREMULOIDES	20.00 (20.00, 5)	0	.10 (.23, 5)	5	20
PSEUDOTSUGA MENZIESII (T)	325.06 (31.63, 5)	100	30.89 (30.12, 5)	295	100
ALL SPECIES			31.00		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND (**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

HERBACEOUS STRATUM-- MIXED BRUSH
SUMMARY-- 15 HERB TRANSECTS WITHIN TYPE-- MIXED BRUSH

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA (STD DEV, N)	**** DENSITY **** NO/HA (STD DEV,N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN (ST.DEV, N)	NUMBER /QUAD.	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
CLEMATIS HIRSUTISSIMA	.67	.05	5,33 (11,25, 15)	400 (843, 10)	.76	2,67 (5,94, 15)	.02	.75	20	1
STIPA SP.	.50	.04	4,00 (15,49, 15)	ID (0, 10)	.95	3.33 (12,91, 15)	ID	ID	7	1
HAPLOPAPPUS NUTALLTI	6,58	.53	52,67 (106,53, 15)	16400 (32630, 10)	6,11	21,33 (36,23, 15)	.82	3,84	40	13
RUMEX UTAHENSIS	.00	.00	.00 (ID ,)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
PENSTEMON SP.	1,17	.09	9,33 (22,75, 15)	800 (2530, 10)	2.10	7,33 (13,87, 15)	.04	.55	33	3
LINUM LEWISII	2.08	.17	16,67 (25,26, 15)	11600 (20128, 10)	4,39	15,33 (22,64, 15)	.58	3,78	47	6
ERIOGONUM UMBELLATUM	5,16	.41	41,33 (119,81, 15)	13400 (37512, 10)	2,48	8,67 (15,06, 15)	.67	7,73	53	8
ERIGERON SP.	.00	.00	.00 (ID ,)	ID (0, 10)	1,53	5,33 (15,98, 15)	ID	ID	13	2
BROMUS SP.	.00	.00	.00 (ID ,)	ID (0, 10)	.38	1,33 (3,52, 15)	ID	ID	13	0
LITHOSPERMUM RUDERALE	.42	.03	3,33 (7,24, 15)	600 (1350, 10)	.57	2,00 (4,14, 15)	.03	1,50	20	1
CREPIS SP.	.04	.00	.33 (1,29, 15)	ID (0, 10)	.38	1,33 (3,52, 15)	ID	ID	13	0
AGROPYRON SP.	1,25	.10	10,00 (25,63, 15)	ID (0, 10)	1,91	6,67 (14,96, 15)	ID	ID	20	3
PHYSARIA FLORIBUNDA	.58	.05	4,67 (7,43, 15)	3600 (4789, 10)	2,67	9,33 (12,80, 15)	.18	1,93	40	3
ANTENNARIA SP.	.00	.00	.00 (ID ,)	ID (0, 10)	.76	2,67 (7,99, 15)	ID	ID	13	1
AGROPYRON SMITHII	.08	.01	.67 (2,58, 15)	ID (0, 10)	.57	2,00 (4,14, 15)	ID	ID	20	1
JUNCUS SAXIMONTANUS	2,33	.19	18,67 (64,24, 15)	5000 (15122, 10)	.95	3,33 (7,24, 15)	.25	7,50	20	3
KOELERIA GRACILIS	2,42	.19	19,33 (33,69, 15)	ID (0, 10)	4,20	14,67 (22,00, 15)	ID	ID	40	7
CYMOPTERUS SP.	.00	.00	.00 (ID ,)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
TARAXACUM OFFICINALE	.00	.00	.00 (ID ,)	ID (0, 10)	.38	1,33 (5,16, 15)	ID	ID	7	0
SENECIO CANUS	1,75	.14	14,00 (51,52, 15)	10600 (33520, 10)	1,34	4,67 (15,52, 15)	.53	11,36	13	3
CRYPTANTHA SP.	.50	.04	4,00 (12,98, 15)	ID (0, 10)	.38	1,33 (3,52, 15)	ID	ID	13	1
POA SANDBERG	3,08	.25	24,67 (71,70, 15)	ID (0, 10)	2,29	8,00 (23,36, 15)	ID	ID	20	5
ORYZOPSIS HYMENOIDES	8,83	.71	70,67 (79,68, 15)	400 (1265, 10)	8,02	28,00 (23,66, 15)	.02	.07	87	17
SOLIDAGO SP.	.08	.01	.67 (2,58, 15)	ID (0, 10)	.38	1,33 (3,52, 15)	ID	ID	13	0
COLLINSIA PARVIFLORA	.04	.00	.33 (1,29, 15)	3200 (6812, 10)	2,29	8,00 (15,68, 15)	.16	2,00	33	2
GENTIANA SP.	.08	.01	.67 (2,58, 15)	ID (0, 10)	.38	1,33 (5,16, 15)	ID	ID	7	0
ERIOGONUM SP.	.08	.01	.67 (2,58, 15)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
ERIOGONUM OVALIFOLIUM	.25	.02	2,00 (7,75, 15)	ID (0, 10)	.57	2,00 (7,75, 15)	ID	ID	7	1
LUPINUS SP.	.25	.02	2,00 (7,75, 15)	ID (0, 10)	.57	2,00 (7,75, 15)	ID	ID	7	1
POA SP.	.04	.00	.33 (1,29, 15)	ID (0, 10)	1,34	4,67 (13,02, 15)	ID	ID	20	1
TRIFOLIUM SP.	.00	.00	.00 (ID ,)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
EPILOBIUM ADENOCAULON	4,00	.32	32,00 (115,89, 15)	ID (0, 10)	2,10	7,33 (21,54, 15)	ID	ID	13	6
PHLOX LONGIFOLIA	.00	.00	.00 (ID ,)	2000 (4422, 10)	1,34	4,67 (9,15, 15)	.10	2,14	27	1
CAREX GEYERI	29,65	2,37	237,33 (418,41, 15)	ID (0, 10)	8,78	30,67 (40,44, 15)	ID	ID	53	38
LYGODESMIA JUNCEA	.08	.01	.67 (2,58, 15)	ID (0, 10)	.38	1,33 (5,16, 15)	ID	ID	7	0
DELPHINIUM NELSONII	.00	.00	.00 (ID ,)	ID (0, 10)	.76	2,67 (7,99, 15)	ID	ID	13	1
OSMORHIZA SP.	.33	.03	2,67 (10,33, 15)	ID (0, 10)	.38	1,33 (5,16, 15)	ID	ID	7	1
U1MB3	.25	.02	2,00 (7,75, 15)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
U2MB3	.08	.01	.67 (2,58, 15)	ID (0, 10)	.38	1,33 (5,16, 15)	ID	ID	7	0
ASTRAGALUS SP.	.00	.00	.00 (ID ,)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
ASTER SP.	.08	.01	.67 (2,58, 15)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
GALIUM BOREALE	.42	.03	3,33 (9,00, 15)	4600 (10244, 10)	1,34	4,67 (10,60, 15)	.23	4,93	20	2
ACHILLEA LANULOSA	.25	.02	2,00 (5,61, 15)	1400 (2989, 10)	.57	2,00 (4,14, 15)	.07	3,50	20	1
CIRSIUM ARVENSE	.00	.00	.00 (ID ,)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
CRYPTANTHA SERICEA	1,33	.11	10,67 (14,86, 15)	9000 (8498, 10)	4,58	16,00 (18,44, 15)	.45	2,81	60	6
MOLDAVICA PARVIFLORA	1,00	.08	8,00 (22,42, 15)	1000 (3162, 10)	1,15	4,00 (12,98, 15)	.05	1,25	13	2
BALSAMORHIZA SAGITTATA	1,17	.09	9,33 (19,44, 15)	400 (843, 10)	.76	2,67 (5,94, 15)	.02	.75	20	2
LAPPULA REDOWSKII	.00	.00	.00 (ID ,)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
ASTRAGALUS DIVERSIFOLIUS	.33	.03	2,67 (7,04, 15)	2600 (3534, 10)	1,15	4,00 (7,37, 15)	.13	3,25	27	1
AGROPYRON TRACHYCAULUM	4,08	.33	32,67 (49,78, 15)	ID (0, 10)	5,34	18,67 (23,56, 15)	ID	ID	47	9
PENSTEMON CAESPITOSUS	4,25	.34	34,00 (70,39, 15)	18200 (30309, 10)	4,96	17,33 (25,49, 15)	.91	5,25	47	9
CHENOPODIUM FREMONTII	.00	.00	.00 (ID ,)	800 (2530, 10)	.38	1,33 (5,16, 15)	.04	3,00	7	0
CREPIS ACUMINATA	.50	.04	4,00 (11,21, 15)	1200 (2150, 10)	.57	2,00 (4,14, 15)	.06	3,00	20	1
HORDEUM BRACHYANTHERUM	1,25	.10	10,00 (31,40, 15)	4200 (11331, 10)	1,15	4,00 (12,98, 15)	.21	5,25	13	2
STIPA COMATA	6,00	.48	48,00 (134,71, 15)	ID (0, 10)	1,91	6,67 (15,89, 15)	ID	ID	20	8
ERIGERON EATONII	.25	.02	2,00 (5,61, 15)	2400 (3864, 10)	1,15	4,00 (6,32, 15)	.12	3,00	33	1
ERYSIMUM ASPERUM	.25	.02	2,00 (5,61, 15)	800 (1932, 10)	.38	1,33 (3,52, 15)	.04	3,00	13	1
HEUCHERA PARVIFOLIA	.33	.03	2,67 (7,99, 15)	600 (1350, 10)	.57	2,00 (5,61, 15)	.03	1,50	13	1
LINUM KINGII	.50	.04	4,00 (15,49, 15)	1200 (3795, 10)	.38	1,33 (5,16, 15)	.06	4,50	7	1
ERIGERON PUMILIS	.25	.02	2,00 (7,75, 15)	1000 (3162, 10)	.76	2,67 (10,33, 15)	.05	1,87	7	1
HEDYSARUM BOREALE	.33	.03	2,67 (7,99, 15)	600 (1350, 10)	.38	1,33 (3,52, 15)	.03	2,25	13	1
LUPINUS CAUDATUS	.50	.04	4,00 (12,98, 15)	1000 (2539, 10)	.76	2,67 (7,99, 15)	.05	1,87	13	1
ANTENNARIA PULCHERRIMA	.08	.01	.67 (2,58, 15)	200 (632, 10)	.19	.67 (2,58, 15)	.01	1,50	7	0
SPHAERALCEA COCCINEA	.17	.01	1,33 (3,52, 15)	400 (843, 10)	.38	1,33 (3,52, 15)	.02	1,50	13	1
ELYMUS CINEREUS	.58	.05	4,67 (12,46, 15)	ID (0, 10)	.38	1,33 (3,52, 15)	ID	ID	13	1
ANGELICA SP.	.42	.03	3,33 (12,91, 15)	1200 (3795, 10)	.57	2,00 (7,75, 15)	.06	3,00	7	1
IPOMOPSIS AGGREGATA	.50	.04	4,00 (10,56, 15)	800 (1687, 10)	.76	2,67 (7,04, 15)	.04	1,50	13	1
COMANDRA UMBELLATA	.83	.07	6,67 (20,93, 15)	6600 (17640, 10)	1,34	4,67 (12,46, 15)	.33	7,07	13	2
BROMUS TECTORUM	.08	.01	.67 (2,58, 15)	1000 (3162, 10)	.38	1,33 (5,16, 15)	.05	3,75	7	0
U1MB3 7/75	.50	.04	4,00 (15,49, 15)	800 (2530, 10)	.57	2,00 (7,75, 15)	.04	2,00	7	1
ASTRAGALUS CHAMAELEUCE	.08	.01	.67 (2,58, 15)	1000 (3162, 10)	.19	.67 (2,58, 15)	.05	7,50	7	0
AGOSERIS GLAUCA	.00	.00	.00 (ID ,)	200 (632, 10)	.19	.67 (2,58, 15)	.01	1,50	7	0
CIRSIUM SP.	.08	.01	.67 (2,58, 15)	200 (632, 10)	.19	.67 (2,58, 15)	.01	1,50	7	0
CAREX SP.	.00	.00	.00 (ID ,)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
CHENOPODIUM LEPTOPHYLLUM	.00	.00	.00 (ID ,)	600 (1897, 10)	.19	.67 (2,58, 15)	.03	4,50	7	0
CASTILLEJA CHROMOSA	.33	.03	2,67 (10,33, 15)	600 (1897, 10)	.57	2,00 (7,75, 15)	.03	1,50	7	1
HELIANTHELLA UNIFLORA	.33	.03	2,67 (10,33, 15)	600 (1897, 10)	.57	2,00 (7,75, 15)	.03	1,50	7	1
SITANION LONGIFOLIUM	.08	.01	.67 (2,58, 15)	ID (0, 10)	.19	.67 (2,58, 15)	ID	ID	7	0
POLYGONUM SAWATCHENSE	.08	.01	.67 (2,58, 15)	1400 (4427, 10)	.19	.67 (2,58, 15)	.07	10,50	7	0
PENSTEMON FREMONTII	.08	.01	.67 (2,58, 15)	400 (1265, 10)	.19	.67 (2,58, 15)	.02	3,00	7	0
ALL SPECIES		8,00	800,33	135000						

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS.
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA.
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- MIXED BRUSH
SUMMARY-- 17 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
JUNIPERUS OSTEOSPERMA	0	0	1	1	,00	6 (17, 17)	,00 (,00, 17)	6 (18, 17)	,00 (,00, 17)	12
PINUS EDULIS	0	0	3	4	,10	16 (33, 17)	10,24 (31,86, 17)	40 (94, 17)	6,56 (4,53, 17)	24
POPULUS TREMULOIDES	0	0	0	1	,00	2 (10, 17)	,00 (,00, 17)	4 (16, 17)	,00 (,00, 17)	6
PSEUDOTSUGA MENZIESII (T)	0	0	0	0	,00	1 (5, 17)	,00 (,00, 17)	1 (4, 17)	,00 (,00, 17)	6
GUTIERRIZIA SAROTHRAE	0	0	1	1	,01	6 (24, 17)	,71 (2,91, 17)	23 (93, 17)	,71 (,71, 17)	6
ARTEMISIA TRIDENTATA	13	27	18	58	7,84	86 (28, 17)	783,59 (564,79, 17)	3653 (3183, 17)	36,06 (3,25, 17)	94
CERCOCARPUS MONTANUS	2	2	3	7	1,49	15 (30, 17)	149,35 (365,46, 17)	241 (653, 17)	25,94 (16,00, 17)	29
CHRYSOTHAMNUS NAUSEOSUS	0	0	1	2	,08	6 (17, 17)	8,00 (32,98, 17)	24 (89, 17)	2,00 (2,00, 17)	12
CHRYSOTHAMNUS VISCIDIFLORUS	1	8	11	20	,45	55 (35, 17)	45,41 (65,64, 17)	1017 (1635, 17)	7,81 (1,89, 17)	88
PRUNUS VIRGINIANA	2	1	3	6	1,12	15 (30, 17)	112,35 (372,67, 17)	185 (471, 17)	7,57 (4,32, 17)	29
PURSHIA TRIDENTATA	3	3	7	13	1,62	34 (42, 17)	162,47 (376,23, 17)	403 (924, 17)	15,75 (6,20, 17)	47
QUERCUS GAMBELII	7	2	4	13	4,16	19 (33, 17)	415,82 (717,09, 17)	279 (725, 17)	59,77 (33,32, 17)	29
ROSA SP.	0	0	0	0	,00	1 (5, 17)	,00 (,00, 17)	2 (8, 17)	,00 (,00, 17)	6
TETRADYMIA CANESCENS	0	3	4	7	,13	18 (28, 17)	13,06 (38,65, 17)	417 (1472, 17)	2,86 (1,37, 17)	41
AMELANCHIER UTAHENSIS	51	22	20	93	30,41	98 (7, 17)	3040,76 (1354,28, 17)	2902 (1407, 17)	103,88 (8,67, 17)	100
SYMPHORICARPOS OREOPHILUS	20	31	20	71	12,24	96 (8, 17)	1223,76 (1013,02, 17)	4100 (3344, 17)	42,75 (3,97, 17)	100
AMELANCHIER ALNIFOLIA	0	0	0	0	,00	1 (5, 17)	,00 (,00, 17)	11 (44, 17)	,00 (,00, 17)	6
OPUNTIA POLYACANTHA	0	0	0	0	,00	2 (10, 17)	,00 (,00, 17)	2 (8, 17)	,00 (,00, 17)	6
CEANOTHUS MARTINI	0	0	0	0	,00	1 (5, 17)	,00 (,00, 17)	26 (109, 17)	,00 (,00, 17)	6
ROSA WOODSII	0	0	1	2	,13	6 (20, 17)	12,53 (45,62, 17)	17 (65, 17)	3,50 (2,82, 17)	12
RIBES INERME	0	0	1	1	,00	4 (8, 17)	,00 (,00, 17)	5 (13, 17)	,00 (,00, 17)	18
ALL SPECIES					59,78		5978,06	13357		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

MATURE TREE STRATUM-- MIXED BRUSH
SUMMARY-- 17 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)
PINUS EDULIS	100	100	100	300	,10	2 (7, 17)	10,29 (42,44, 17)	2 (6, 17)
ALL SPECIES					,10		10,29	2

SPECIES	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	***** BASAL AREA ***** RELATIVE	M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
PINUS EDULIS	10,29 (10,29, 17)	100	,03 (,08, 17)	300	12
ALL SPECIES			,03		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND
(**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

HERBACEOUS STRATUM-- PINYON/JUNIPER
SUMMARY-- 21 HERB TRANSECTS WITHIN TYPE-- PINYON/JUNIPER

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA	(STD DEV, N)	**** DENSITY **** NO/HA	(STD DEV,N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN	(ST,DEV, N)	NUMBER /QUAD,	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
POA SP,	,90	,04	3,81	(11,93, 21)	ID	(0, 14)	1,54	5,24	(12,89, 21)	ID	ID	19	2
ERIOGONUM UMBELLATUM	1,23	,05	5,24	(13,27, 21)	1143	(2905, 14)	,84	2,86	(7,17, 21)	,06	2,00	14	2
AGROPYRON SP,	2,86	,12	12,14	(39,23, 21)	ID	(0, 14)	3,92	13,33	(23,09, 21)	ID	ID	29	7
AGOSERIS SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
SENECIO SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
PHLOX LONGIFOLIA	,00	,00	,00	(ID ,)	1000	(3742, 14)	,42	1,43	(4,78, 21)	,05	3,50	10	0
PHYSARIA FLORIBUNDA	,22	,01	,95	(4,36, 21)	2000	(3679, 14)	1,82	6,19	(10,24, 21)	,10	1,62	33	2
POA SANDBERG	8,08	,34	34,29	(62,42, 21)	ID	(0, 14)	5,18	17,62	(26,63, 21)	ID	ID	57	13
ERIGERON SP,	,06	,00	,24	(1,09, 21)	ID	(0, 14)	1,12	3,81	(7,40, 21)	ID	ID	24	1
KOFLERIA GRACILIS	5,78	,25	24,52	(61,46, 21)	ID	(0, 14)	4,76	16,19	(26,74, 21)	ID	ID	43	11
PHLOX MULTIFLORA	1,74	,07	7,38	(20,22, 21)	ID	(0, 14)	2,52	8,57	(19,05, 21)	ID	ID	24	4
ORYZOPSIS HYMENOIDES	9,42	,40	40,00	(38,99, 21)	ID	(0, 14)	8,96	30,48	(22,02, 21)	ID	ID	86	18
ANTENNARIA SP,	,79	,03	3,33	(13,17, 21)	ID	(0, 14)	1,54	5,24	(12,09, 21)	ID	ID	19	2
COMPOSITAE	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
SITANION LONGIFOLIUM	1,85	,08	7,86	(17,29, 21)	ID	(0, 14)	2,10	7,14	(11,02, 21)	ID	ID	38	4
CRYPTANTHA SP,	,56	,02	2,38	(6,25, 21)	ID	(0, 14)	,98	3,33	(8,56, 21)	ID	ID	14	2
ASTRAGALUS SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
AGROPYRON TRACHYCAULUM	16,15	,69	68,57	(100,16, 21)	ID	(0, 14)	10,64	36,19	(30,41, 21)	ID	ID	67	27
HAPLOPAPPUS NUTALLII	6,00	,25	25,48	(30,49, 21)	5857	(5461, 14)	5,60	19,05	(13,38, 21)	,29	1,54	71	12
STIPA SP,	1,68	,07	7,14	(27,55, 21)	ID	(0, 14)	1,12	3,81	(13,59, 21)	ID	ID	10	3
ARENARIA SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,28	,95	(4,36, 21)	ID	ID	5	0
AGROPYRON SMITHII	3,25	,14	13,81	(52,01, 21)	ID	(0, 14)	2,24	7,62	(12,61, 21)	ID	ID	43	5
CHAENACTIS DOUGLASII	,00	,00	,00	(ID ,)	143	(535, 14)	,56	1,90	(6,80, 21)	,01	,38	10	1
U1PJ3	,00	,00	,00	(ID ,)	ID	(0, 14)	,56	1,90	(8,73, 21)	ID	ID	5	1
PHIS ? PJ3-6/75	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
ARENARIA EASTWOODIAE	,22	,01	,95	(3,01, 21)	2143	(4258, 14)	,98	3,33	(6,58, 21)	,11	3,21	24	1
STREPTANTHUS CORDATUS	,22	,01	,95	(4,36, 21)	286	(726, 14)	,42	1,43	(3,59, 21)	,01	1,00	14	1
ERIOGONUM SP,	,39	,02	1,67	(7,64, 21)	ID	(0, 14)	,42	1,43	(6,55, 21)	ID	ID	5	1
LOMATIUM SP,	,06	,00	,24	(1,09, 21)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
SISYMBRIUM SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,42	1,43	(4,78, 21)	ID	ID	10	0
CAREX SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
TRIFOLIUM GYMNOCARPON	,22	,01	,95	(4,36, 21)	2429	(6756, 14)	1,96	6,67	(14,94, 21)	,12	1,82	19	2
PENSTEMON SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
JUNCUS SAXIMONTANUS	,22	,01	,95	(3,01, 21)	286	(726, 14)	,42	1,43	(3,59, 21)	,01	1,00	14	1
CAREX GEYERI	1,51	,06	6,43	(10,62, 21)	ID	(0, 14)	1,26	4,29	(7,46, 21)	ID	ID	29	3
SPHAERALCEA COCCINEA	2,80	,12	11,90	(36,42, 21)	12000	(21965, 14)	1,54	5,24	(8,73, 21)	,60	11,45	33	4
EPILOBIUM ADENOCAULON	5,44	,23	23,10	(70,54, 21)	ID	(0, 14)	1,40	4,76	(12,09, 21)	ID	ID	14	7
ASTRAGALUS CHAMAELEUCE	,06	,00	,24	(1,09, 21)	714	(1684, 14)	,70	2,38	(5,39, 21)	,04	1,50	19	1
ANDROSACE SEPTENTRIONALIS	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
CRYPTANTHA SERICEA	3,98	,17	16,90	(23,48, 21)	20286	(22310, 14)	6,72	22,86	(21,94, 21)	1,01	4,44	67	11
PHLOX HOODII	4,82	,20	20,48	(34,71, 21)	13571	(15791, 14)	5,74	19,52	(25,59, 21)	,68	3,48	52	11
BROMUS TECTORUM	,28	,01	1,19	(4,45, 21)	ID	(0, 14)	,28	,95	(3,01, 21)	ID	ID	10	1
CYMOPTERUS SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,42	1,43	(4,78, 21)	ID	ID	10	0
DELPHINIUM SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
AGOSERIS GLAUCA	,11	,00	,48	(2,18, 21)	571	(2138, 14)	,56	1,90	(6,80, 21)	,03	1,50	10	1
POA FENDLERIANA	,56	,02	2,38	(10,91, 21)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	1
CREPIS SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
U1PJ15	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
BALSAMORHIZA SAGITTATA	,45	,02	1,90	(5,12, 21)	286	(726, 14)	,42	1,43	(3,59, 21)	,01	1,00	14	1
CHENOPODIUM FREMONTII	,22	,01	,95	(3,01, 21)	1429	(3275, 14)	,56	1,90	(4,02, 21)	,07	3,75	19	1
EUPHORBIA SP,	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
DESCURAINIA PINNATA	,00	,00	,00	(ID ,)	ID	(0, 14)	,28	,95	(4,36, 21)	ID	ID	5	0
LAPPULA REDOWSKII	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
ERIOGONUM LONCHOPHYLLUM	3,37	,14	14,29	(32,34, 21)	8429	(16346, 14)	2,66	9,05	(19,47, 21)	,42	4,66	19	6
EUPHORBIA FENDLERI	3,37	,14	14,29	(25,80, 21)	9000	(11655, 14)	3,22	10,95	(20,95, 21)	,45	4,11	29	7
ASTRAGALUS DIVERSIFOLIUS	,56	,02	2,38	(5,39, 21)	1429	(2409, 14)	,70	2,38	(4,36, 21)	,07	3,00	24	1
STIPA COMATA	4,04	,17	17,14	(55,69, 21)	ID	(0, 14)	2,38	8,10	(20,89, 21)	ID	ID	24	6
ERIGERON EATONII	,67	,03	2,86	(7,17, 21)	2714	(4122, 14)	1,82	6,19	(12,44, 21)	,14	2,19	33	2
HYMENOPAPPUS FILIFOLIUS	,79	,03	3,33	(10,65, 21)	857	(2179, 14)	,84	2,86	(9,02, 21)	,04	1,50	10	2
IPOMOPSIS CONGESTA	,22	,01	,95	(3,01, 21)	1286	(3292, 14)	,84	2,86	(9,02, 21)	,06	2,25	10	1
SENECIO MULTILOBATUS	,22	,01	,95	(3,01, 21)	1000	(2801, 14)	,28	,95	(3,01, 21)	,05	5,25	10	1
ANTENNARIA MICROPHYLLA	,00	,00	,00	(ID ,)	143	(535, 14)	,14	,48	(2,18, 21)	,01	1,50	5	0
CREPIS ACUMINATA	,11	,00	,48	(2,18, 21)	286	(1069, 14)	,14	,48	(2,18, 21)	,01	3,00	5	0
PENSTEMON CAESPITOSUS	,67	,03	2,86	(6,44, 21)	1143	(2179, 14)	,84	2,86	(6,44, 21)	,06	2,00	19	2
ASTRAGALUS PURSHII	,00	,00	,00	(ID ,)	286	(1069, 14)	,14	,48	(2,18, 21)	,01	3,00	5	0
AGROPYRON INERME	,67	,03	2,86	(13,09, 21)	ID	(0, 14)	,84	2,86	(13,09, 21)	ID	ID	5	2
LYGODESMIA JUNCEA	,00	,00	,00	(ID ,)	ID	(0, 14)	,14	,48	(2,18, 21)	ID	ID	5	0
CASTILLEJA LINARIAEFOLIA	,22	,01	,95	(4,36, 21)	143	(535, 14)	,14	,48	(2,18, 21)	,01	1,50	5	0
ASTRAGALUS SPATULATUS	,11	,00	,48	(2,18, 21)	1571	(4164, 14)	,56	1,90	(6,80, 21)	,08	4,13	10	1
MOSS	2,69	,11	11,43	(35,40, 21)	ID	(0, 14)	,70	2,38	(6,25, 21)	ID	ID	14	3
POLYGONUM SAWATCHENSE	,00	,00	,00	(ID ,)	429	(1604, 14)	,14	,48	(2,18, 21)	,02	4,50	5	0
ASTER CAMPESTRIS	,11	,00	,48	(2,18, 21)	143	(535, 14)	,14	,48	(2,18, 21)	,01	1,50	5	0
ALL SPECIES		4,25	424,52		93000								

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS,
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA,
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- PINYON/JUNIPER
SUMMARY-- 23 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
JUNIPERUS OSTEOSPERMA	2	2	8	12	,18	39 (34, 23)	18,39 (41,93, 23)	82 (114, 23)	12,51 (5,52, 23)	70
PINUS EDULIS	9	8	16	32	,98	72 (31, 23)	97,78 (149,54, 23)	293 (235, 23)	31,33 (7,86, 23)	96
GUTIERRIZIA SAROTHRAE	0	4	3	8	,04	14 (34, 23)	4,43 (19,20, 23)	159 (486, 23)	1,77 (1,38, 23)	17
ARTEMISIA TRIDENTATA	42	44	18	105	4,76	83 (27, 23)	476,26 (548,89, 23)	1707 (1620, 23)	33,32 (4,89, 23)	100
ATRIPLEX CONFERTIFOLIA	3	1	2	5	,34	8 (22, 23)	33,52 (134,99, 23)	23 (63, 23)	11,02 (6,61, 23)	13
CERCOCARPUS MONTANUS	5	4	6	16	,60	28 (37, 23)	59,74 (98,92, 23)	170 (292, 23)	18,83 (5,42, 23)	43
CHRYSOTHAMNUS NAUSEOSUS	0	2	4	7	,03	18 (26, 23)	3,43 (13,90, 23)	89 (234, 23)	1,24 (,99, 23)	52
CHRYSOTHAMNUS VISCIDIFLORUS	3	7	8	18	,32	37 (42, 23)	31,83 (56,22, 23)	260 (386, 23)	13,90 (7,30, 23)	52
EPHEDRA VIRIDIS	0	0	0	1	,00	2 (8, 23)	,00 (,00, 23)	5 (24, 23)	,00 (,00, 23)	4
EUROTIA LANATA	0	0	1	1	,00	3 (13, 23)	,00 (,00, 23)	12 (56, 23)	,00 (,00, 23)	4
PURSHIA TRIDENTATA	8	6	10	24	,92	44 (42, 23)	91,87 (131,30, 23)	249 (375, 23)	30,72 (10,54, 23)	65
TETRADYMIA CANESCENS	0	2	3	5	,04	13 (19, 23)	3,83 (9,64, 23)	59 (120, 23)	2,70 (1,31, 23)	39
AMELANCHIER UTAHENSIS	24	13	9	46	2,72	43 (42, 23)	272,17 (439,35, 23)	483 (785, 23)	29,70 (8,39, 23)	65
SYMPHORICARPOS OREOPHILUS	2	4	5	12	,23	24 (30, 23)	23,04 (44,39, 23)	164 (444, 23)	8,06 (3,00, 23)	52
OPUNTIA POLYACANTHA	0	1	4	6	,05	19 (25, 23)	5,22 (14,84, 23)	43 (77, 23)	3,04 (1,70, 23)	52
OPUNTIA FRAGILIS	0	1	2	2	,01	8 (22, 23)	,61 (2,92, 23)	27 (78, 23)	,61 (,61, 23)	13
CEANOTHUS MARTINI	0	0	0	0	,01	2 (8, 23)	,96 (4,59, 23)	1 (7, 23)	,96 (,96, 23)	4
ALL SPECIES					11,27		1127,35	3838		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY,
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,

MATURE TREE STRATUM-- PINYON/JUNIPER
SUMMARY-- 23 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)
JUNIPERUS OSTEOSPERMA	43	54	54	151	9,26	75 (33, 23)	926,17 (693,08, 23)	138 (109, 23)
PINUS EDULIS	57	46	46	149	12,13	62 (32, 23)	1212,91 (1030,27, 23)	118 (103, 23)
ALL SPECIES					21,39		2139,09	256

	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	**************** BASAL AREA *************** RELATIVE	M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
JUNIPERUS OSTEOSPERMA	208,62 (29,56, 23)	59	22,34 (29,57, 23)	167	87
PINUS EDULIS	249,84 (37,90, 23)	41	15,56 (28,75, 23)	133	91
ALL SPECIES			37,90		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND
(**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY,
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,

HERBACEOUS STRATUM-- SAGEBRUSH
SUMMARY-- 20 HERB TRANSECTS WITHIN TYPE-- SAGEBRUSH

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA	(STD DEV, N)	**** DENSITY **** NO/HA	(STD DEV, N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN	(ST.DEV, N)	NUMBER /QUAD.	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
ERIOGONUM OVALIFOLIUM	.04	.00	.50	(2.24, 20)	154	(555, 13)	.21	1.00	(3.08, 20)	.01	.77	10	0
PHLOX MULTIFLORA	5.27	.66	66.25	(179.98, 20)	8462	(21137, 13)	1.68	8.00	(19.08, 20)	.42	5.29	20	7
SPHAERALCEA COCCINEA	.84	.10	10.50	(22.12, 20)	13846	(21870, 13)	2.62	12.50	(21.24, 20)	.69	5.54	40	3
ORYZOPSIS HYMENOIDES	2.75	.34	34.50	(60.11, 20)	ID	(0, 13)	4.09	19.50	(27.62, 20)	ID	ID	50	7
RORIPPA NASTURTIUM AQUATICUM	.06	.01	.75	(3.35, 20)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
U1S1	.04	.00	.50	(2.24, 20)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
POA SANDBERG	9.05	1.14	113.75	(225.46, 20)	ID	(0, 13)	4.93	23.50	(40.04, 20)	ID	ID	30	14
HEDYSARUM BOREALE	2.03	.25	25.50	(69.62, 20)	1231	(3419, 13)	.42	2.00	(4.10, 20)	.06	3.08	20	2
AGROPYRON SP.	.84	.10	10.50	(29.64, 20)	ID	(0, 13)	2.73	13.00	(24.52, 20)	ID	ID	30	4
PHLOX LONGIFOLIA	.82	.10	10.25	(23.87, 20)	16000	(27905, 13)	2.94	14.00	(23.49, 20)	.80	5.71	35	4
BROMUS TECTORUM	.28	.03	3.50	(9.88, 20)	ID	(0, 13)	.73	3.50	(7.45, 20)	ID	ID	25	1
CRYPTANTHA SP.	.30	.04	3.75	(15.63, 20)	ID	(0, 13)	.52	2.50	(7.86, 20)	ID	ID	10	1
AGROPYRON SMITHII	5.33	.67	67.00	(121.02, 20)	308	(1109, 13)	5.24	25.00	(25.65, 20)	.02	.06	60	11
STIPA SP.	.22	.03	2.75	(9.39, 20)	ID	(0, 13)	.63	3.00	(8.01, 20)	ID	ID	15	1
CYMOPTERUS SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
SISYMBRIUM ALTISSIMUM	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
POA SP.	3.64	.46	45.75	(136.15, 20)	ID	(0, 13)	2.41	11.50	(24.55, 20)	ID	ID	30	6
AGOSERIS SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.31	1.50	(4.89, 20)	ID	ID	10	0
TRIFOLIUM GYMNOCARPON	1.41	.18	17.75	(49.32, 20)	12769	(31300, 13)	2.31	11.00	(27.32, 20)	.64	5.80	15	4
ERIGERON SP.	.26	.03	3.25	(12.38, 20)	ID	(0, 13)	1.26	6.00	(20.88, 20)	ID	ID	10	2
PHLOX HOODII	4.26	.53	53.50	(170.27, 20)	7385	(17173, 13)	2.10	10.00	(22.48, 20)	.37	3.69	25	6
LUPINUS SP.	1.41	.18	17.75	(55.97, 20)	ID	(0, 13)	1.15	5.50	(16.69, 20)	ID	ID	15	3
ZIGADENUS VENENOSUS	.04	.00	.50	(2.24, 20)	308	(1109, 13)	.42	2.00	(6.16, 20)	.02	.77	10	0
CASTILLEJA CHROMOSA	.28	.03	3.50	(9.88, 20)	923	(2253, 13)	1.26	6.00	(12.73, 20)	.05	.77	20	2
U1S2	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
U2S2	.16	.02	2.00	(8.94, 20)	ID	(0, 13)	.42	2.00	(8.94, 20)	ID	ID	5	1
PENSTEMON SP.	.64	.08	8.00	(24.84, 20)	ID	(0, 13)	1.15	5.50	(17.01, 20)	ID	ID	10	2
U3S2	.24	.03	3.00	(13.42, 20)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
DELPHINIUM SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
CALOCHORTUS SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
LOMATIUM SP.	.08	.01	1.00	(3.08, 20)	ID	(0, 13)	.94	4.50	(13.95, 20)	ID	ID	10	1
ANDROSACE SEPTENTRIONALIS	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
SENECIO SP.	.06	.01	.75	(3.35, 20)	ID	(0, 13)	.21	1.00	(3.08, 20)	ID	ID	10	0
SOLIDAGO SP.	.10	.01	1.25	(5.59, 20)	ID	(0, 13)	.84	4.00	(13.92, 20)	ID	ID	10	1
ASTRAGALUS SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.21	1.00	(3.08, 20)	ID	ID	10	0
KOELERIA GRACILIS	2.13	.27	26.75	(71.71, 20)	ID	(0, 13)	2.94	14.00	(24.79, 20)	ID	ID	40	5
POA CUSICKII	.04	.00	.50	(2.24, 20)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
PHYSARIA FLORIBUNDA	.08	.01	1.00	(3.08, 20)	1231	(1922, 13)	.63	3.00	(4.70, 20)	.06	2.05	30	1
LYGODESMIA JUNCEA	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
TARAXACUM OFFICINALE	.08	.01	1.00	(3.08, 20)	1231	(3419, 13)	.73	3.50	(8.13, 20)	.06	1.76	20	1
CAREX GEYERI	14.17	1.78	178.00	(471.82, 20)	ID	(0, 13)	2.62	12.50	(30.76, 20)	ID	ID	15	17
ERIOGONUM UMBELLATUM	2.27	.28	28.50	(75.62, 20)	11385	(27427, 13)	1.78	8.50	(20.07, 20)	.57	6.70	20	4
CAREX SP.	.32	.04	4.00	(17.89, 20)	ID	(0, 13)	.31	1.50	(6.71, 20)	ID	ID	5	1
DELPHINIUM NELSONII	.00	.00	.00	(ID ,)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
BROMUS SP.	.08	.01	1.00	(4.47, 20)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
GERANIUM RICHARDSONII	1.19	.15	15.00	(50.11, 20)	2615	(6995, 13)	1.05	5.00	(14.69, 20)	.13	2.62	15	2
MERTENSIA SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
SITANION LONGIFOLIUM	1.17	.15	14.75	(49.51, 20)	ID	(0, 13)	2.52	12.00	(17.95, 20)	ID	ID	40	4
PHYSARIA SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
U1S4	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
U2S4	.00	.00	.00	(ID ,)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
SISYMBRIUM SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	1.05	5.00	(12.77, 20)	ID	ID	20	1
CREPIS ACUMINATA	.52	.06	6.50	(24.55, 20)	2769	(7190, 13)	1.47	7.00	(17.80, 20)	.14	1.98	15	2
TRIFOLIUM SP.	.22	.03	2.75	(12.30, 20)	ID	(0, 13)	.63	3.00	(13.42, 20)	ID	ID	5	1
EUPHORBIA ROBUSTA	.02	.00	.25	(1.12, 20)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
HAPLOPAPPUS ACAULIS	.02	.00	.25	(1.12, 20)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
PHLOX SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.31	1.50	(6.71, 20)	ID	ID	5	0
EPILOBIUM ADENOCAULON	.00	.00	.00	(ID ,)	ID	(0, 13)	.31	1.50	(4.89, 20)	ID	ID	10	[illegible]
HERACLEUM LANATUM	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
OENOTHERA SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
PLANTAGO SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
SPHAERALCEA SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
VIOLA NUTTALLII	.08	.01	1.00	(4.47, 20)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
LEPIDIUM MONTANUM	.58	.07	7.25	(29.09, 20)	9692	(34946, 13)	.84	4.00	(13.92, 20)	.48	12.12	10	1
ELYMUS CINEREUS	2.69	.34	33.75	(115.06, 20)	ID	(0, 13)	1.15	5.50	(17.01, 20)	ID	ID	10	4
HORDEUM JUBATUM	.20	.02	2.50	(11.18, 20)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
U1S11 (DESC.)	.30	.04	3.75	(16.77, 20)	ID	(0, 13)	.84	4.00	(17.89, 20)	ID	ID	5	1
CHENOPODIUM FREMONTII	.32	.04	4.00	(10.46, 20)	8615	(16899, 13)	1.68	8.00	(16.42, 20)	.43	5.38	25	2
SENECIO MULTILOBATUS	.24	.03	3.00	(13.42, 20)	154	(555, 13)	.52	2.50	(9.10, 20)	.01	.31	10	1
LEPIDIUM SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
KOCHIA SP.	.00	.00	.00	(ID ,)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	0
ASTRAGALUS CHAMAELEUCE	.04	.00	.50	(2.24, 20)	923	(2397, 13)	.52	2.50	(7.86, 20)	.05	1.85	10	1
HAPLOPAPPUS NUTTALLII	.08	.01	1.00	(3.08, 20)	462	(1198, 13)	.21	1.00	(3.08, 20)	.02	2.31	10	0
IPOMOPSIS CONGESTA	.08	.01	1.00	(3.08, 20)	769	(1922, 13)	.42	2.00	(6.16, 20)	.04	1.92	10	0
POA FENDLERIANA	1.23	.15	15.50	(47.96, 20)	ID	(0, 13)	.94	4.50	(12.76, 20)	ID	ID	15	2
CRYPTANTHA SERICEA	.72	.09	9.00	(23.82, 20)	11538	(19064, 13)	1.78	8.50	(15.31, 20)	.58	6.79	30	2
STIPA COMATA	1.31	.16	16.50	(40.30, 20)	ID	(0, 13)	1.68	8.00	(19.89, 20)	ID	ID	25	3
ERYSIMUM ASPERUM	.04	.00	.50	(2.24, 20)	1077	(2783, 13)	.52	2.50	(7.16, 20)	.05	2.15	15	1
ERIGERON EATONII	1.31	.16	16.50	(42.46, 20)	17846	(34530, 13)	2.94	14.00	(28.91, 20)	.69	6.37	25	4
PENSTEMON CAESPITOSUS	2.98	.38	37.50	(115.53, 20)	15385	(37633, 13)	2.10	10.00	(30.78, 20)	.77	7.69	10	5
AGOSERIS GLAUCA	.16	.02	2.00	(8.94, 20)	2462	(7753, 13)	.73	3.50	(13.48, 20)	.12	3.52	10	1
LUPINUS CAUDATUS	8.60	1.08	108.00	(266.81, 20)	13538	(19186, 13)	3.77	18.00	(29.49, 20)	.68	3.76	30	12
POLYGONUM SAWATCHENSE	.00	.00	.00	(ID ,)	154	(555, 13)	.10	.50	(2.24, 20)	.01	1.54	5	0
CASTILLEJA LINARIAEFOLIA	.04	.00	.50	(2.24, 20)	462	(1198, 13)	.31	1.50	(4.89, 20)	.02	1.54	10	0
PENSTEMON FREMONTII	.44	.05	5.50	(22.35, 20)	1385	(3948, 13)	.52	2.50	(9.10, 20)	.07	2.77	10	1
IPOMOPSIS AGGREGATA	.16	.02	2.00	(5.23, 20)	1846	(3211, 13)	.63	3.00	(6.57, 20)	.09	3.08	20	1
POA PRATENSIS	.24	.03	3.00	(13.42, 20)	ID	(0, 13)	.21	1.00	(4.47, 20)	ID	ID	5	0
ERIGERON PUMILIS	.16	.02	2.00	(6.96, 20)	615	(1710, 13)	.31	1.50	(4.89, 20)	.03	2.05	10	0
GALIUM BOREALE	3.86	.48	48.50	(149.29, 20)	55077	(135746, 13)	1.89	9.00	(27.70, 20)	2.75	30.60	10	6
ERIGERON SPECIOSUS	.96	.12	12.00	(37.50, 20)	14462	(36057, 13)	.84	4.00	(12.73, 20)	.72	18.08	10	2
STIPA COLUMBIANA	1.63	.20	20.50	(91.68, 20)	ID	(0, 13)	.94	4.50	(20.12, 20)	ID	ID	5	3
CALOCHORTUS NUTTALLII	.04	.00	.50	(2.24, 20)	154	(555, 13)	.10	.50	(2.24, 20)	.01	1.54	5	0
ACHILLEA LANULOSA	.28	.03	3.50	(11.82, 20)	3846	(9397, 13)	.52	2.50	(7.86, 20)	.19	7.69	10	1
CLEMATIS HIRSUTISSIMA	.04	.00	.50	(2.24, 20)	154	(555, 13)	.10	.50	(2.24, 20)	.01	1.54	5	0
OSMORHIZA DEPAUPERATA	.08	.01	1.00	(4.47, 20)	308	(1109, 13)	.10	.50	(2.24, 20)	.02	3.08	5	0
COMANDRA UMBELLATA	1.19	.15	15.00	(46.28, 20)	7538	(18406, 13)	.63	3.00	(9.23, 20)	.38	12.56	10	2
COLLOMIA LINEARIS	.00	.00	.00	(ID ,)	154	(555, 13)	.10	.50	(2.24, 20)	.01	1.54	5	0
ASTRAGALUS TENELLUS	.44	.05	5.50	(18.77, 20)	1846	(5129, 13)	.63	3.00	(9.79, 20)	.09	3.08	10	1
HELIANTHELLA UNIFLORA	.48	.06	6.00	(19.57, 20)	3385	(8422, 13)	.42	2.00	(6.16, 20)	.17	8.46	10	1
AGROPYRON TRACHYCAULUM	.24	.03	3.00	(6.57, 20)	ID	(0, 13)	1.47	7.00	(14.18, 20)	ID	ID	25	2
EUPHORBIA FENDLERI	.04	.00	.50	(2.24, 20)	154	(555, 13)	.21	1.00	(3.08, 20)	.01	.77	10	0
LAPPULA REDOWSKII	.00	.00	.00	(ID ,)	615	(1710, 13)	.42	2.00	(6.96, 20)	.03	1.54	10	0
DESCURAINIA PINNATA	.04	.00	.50	(2.24, 20)	2308	(6725, 13)	.42	2.00	(6.16, 20)	.12	5.77	10	0
ASTRAGALUS DIVERSIFOLIUS	.00	.00	.00	(ID ,)	308	(1109, 13)	.21	1.00	(4.47, 20)	.02	1.54	5	0
ASTRAGALUS PURSHII	.00	.00	.00	(ID ,)	154	(555, 13)	.10	.50	(2.24, 20)	.01	1.54	5	0
CHENOPODIUM LEPTOPHYLLUM	.28	.03	3.50	(8.13, 20)	8923	(13257, 13)	1.99	9.50	(21.64, 20)	.45	4.70	25	2
LEPIDIUM PERFOLIATUM	.68	.06	8.50	(38.01, 20)	10000	(36056, 13)	.94	4.50	(20.12, 20)	.50	11.11	5	2
KOCHIA IRANICA	.08	.01	1.00	(3.08, 20)	308	(751, 13)	.21	1.00	(3.08, 20)	.02	1.54	10	0
ANTENNARIA PULCHERRIMA	.04	.00	.50	(2.24, 20)	308	(1109, 13)	.21	1.00	(4.47, 20)	.02	1.54	5	0
POA CANBYI	1.11	.14	14.00	(62.61, 20)	ID	(0, 13)	.63	3.00	(13.42, 20)	ID	ID	5	2
MOSS	.84	.10	10.50	(25.23, 20)	ID	(0, 13)	1.15	5.50	(13.17, 20)	ID	ID	20	2
STIPA COLUMBIANA	2.63	.33	33.00	(147.58, 20)	ID	(0, 13)	.94	4.50	(20.12, 20)	ID	ID	5	4
LIGUSTICUM PORTERI	.16	.02	2.00	(8.94, 20)	462	(1664, 13)	.10	.50	(2.24, 20)	.02	4.62	5	[illegible]
AGROPYRON SPICATUM	.16	.02	2.00	(8.94, 20)	ID	(0, 13)	.10	.50	(2.24, 20)	ID	ID	5	[illegible]
SISYMBRIUM LINIFOLIUM	.00	.00	.00	(ID ,)	308	(1109, 13)	.10	.50	(2.24, 20)	.02	3.08	5	0
ALL SPECIES		12.56	1256.50		278308								

NOTES: 1) ID= INSUFFICIENT DATA. DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS.
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA.
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- SAGEBRUSH
SUMMARY-- 25 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
JUNIPERUS OSTEOSPERMA	0	0	2	3	,04	10 (23, 25)	3,96 (13,71, 25)	18 (55, 25)	1,50 (1,11, 25)	20
PINUS EDULIS	0	0	4	4	,06	15 (21, 25)	6,40 (21,61, 25)	17 (24, 25)	6,40 (4,32, 25)	40
GUTIERRIZIA SAROTHRAE	1	1	3	5	,22	14 (34, 25)	21,92 (103,03, 25)	100 (244, 25)	11,00 (10,30, 25)	16
ARTEMISIA TRIDENTATA	73	59	25	157	25,01	98 (6, 25)	2500,92 (974,08, 25)	8249 (3558, 25)	39,13 (2,61, 25)	100
ATRIPLEX CANESCENS	0	0	0	0	,00	2 (6, 25)	,44 (2,20, 25)	3 (14, 25)	,44 (,44, 25)	8
ATRIPLEX CONFERTIFOLIA	0	0	1	1	,03	4 (20, 25)	2,96 (14,80, 25)	32 (160, 25)	1,48 (1,48, 25)	4
CERCOCARPUS MONTANUS	.0	0	0	1	,08	1 (4, 25)	8,40 (42,00, 25)	10 (50, 25)	4,20 (4,20, 25)	4
CHRYSOTHAMNUS NAUSEOSUS	3	3	5	11	1,06	21 (36, 25)	105,72 (293,90, 25)	412 (1057, 25)	6,12 (3,29, 25)	32
CHRYSOTHAMNUS VISCIDIFLORUS	6	23	20	49	1,96	81 (33, 25)	195,52 (272,60, 25)	3175 (4741, 25)	12,24 (2,31, 25)	92
EUROTIA LANATA	0	0	2	3	,03	9 (25, 25)	3,28 (11,24, 25)	64 (188, 25)	1,74 (1,13, 25)	12
PURSHIA TRIDENTATA	1	0	2	3	,18	9 (23, 25)	17,96 (65,31, 25)	34 (128, 25)	5,21 (2,90, 25)	16
ROSA SP.	0	0	0	0	,00	1 (4, 25)	,00 (,00, 25)	1 (7, 25)	,00 (,00, 25)	4
SARCOBATUS VERMICULATUS	1	1	2	3	,32	7 (22, 25)	32,48 (113,13, 25)	99 (337, 25)	3,45 (2,42, 25)	12
TETRADYMIA CANESCENS	0	1	4	6	,09	18 (32, 25)	9,32 (33,60, 25)	139 (298, 25)	3,06 (1,62, 25)	28
AMELANCHIER UTAHENSIS	7	3	10	20	2,43	41 (47, 25)	243,00 (535,50, 25)	439 (688, 25)	22,16 (7,94, 25)	52
SYMPHORICARPOS OREOPHILUS	8	7	12	27	2,78	48 (47, 25)	278,44 (576,83, 25)	985 (2055, 25)	18,07 (4,32, 25)	60
OPUNTIA POLYACANTHA	0	1	5	5	,05	18 (32, 25)	4,72 (13,16, 25)	95 (275, 25)	1,91 (1,09, 25)	32
RIBES CEREUM	0	0	1	1	,00	2 (9, 25)	,00 (,00, 25)	5 (21, 25)	,00 (,00, 25)	8
SORBUS SCOPULINA	0	0	0	0	,01	1 (4, 25)	1,00 (5,00, 25)	2 (10, 25)	,33 (,33, 25)	4
ALL SPECIES					34,36		3436,44	13880		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

MATURE TREE STRATUM-- SAGEBRUSH
SUMMARY-- 25 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)
JUNIPERUS OSTEOSPERMA	0	67	67	133	,00	2 (6, 25)	,00 (,00, 25)	1 (5, 25)
PINUS EDULIS	0	33	33	67	,00	1 (4, 25)	,00 (,00, 25)	1 (3, 25)
ALL SPECIES					,00		,00	2

SPECIES	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	**************** BASAL AREA *************** RELATIVE	M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
JUNIPERUS OSTEOSPERMA	,00 (,00, 25)	85	,22 (,82, 25)	218	8
PINUS EDULIS	,00 (,00, 25)	15	,04 (,20, 25)	82	4
ALL SPECIES			,27		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND
(**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

HERBACEOUS STRATUM-- GREASEWOOD
SUMMARY-- 9 HERB TRANSECTS WITHIN TYPE-- GREASEWOOD

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA (STD DEV, N)	**** DENSITY **** NO/HA (STD DEV,N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN (ST,DEV, N)	NUMBER /QUAD,	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
BROMUS TECTORUM	7,46	1,44	143,89 (343,65, 9)	ID (0, 6)	6,38	20,00 (37,08, 9)	ID	ID	33	14
CHENOPODIUM FREMONTII	17,00	3,28	327,78 (291,55, 9)	400000 (358769, 6)	22,70	71,11 (30,18, 9)	20,00	28,13	89	40
DESCURAINIA SP,	2,30	,44	44,44 (74,89, 9)	ID (0, 6)	8,51	26,67 (40,31, 9)	ID	ID	33	11
LAPPULA REDOWSKII	5,33	1,03	102,78 (302,73, 9)	7000 (12247, 6)	7,80	24,44 (31,27, 9)	,35	1,43	56	13
AGROPYRON SMITHII	14,09	2,72	271,67 (388,31, 9)	ID (0, 6)	13,83	43,33 (44,16, 9)	ID	ID	78	28
ELYMUS CINEREUS	,55	,11	10,56 (16,29, 9)	ID (0, 6)	1,77	5,56 (8,82, 9)	ID	ID	33	2
AGROPYRON SPICATUM	,52	,10	10,00 (28,17, 9)	ID (0, 6)	3,19	10,00 (26,46, 9)	ID	ID	22	4
LEPIDIUM SP,	,00	,00	,00 (ID ,)	ID (0, 6)	,71	2,22 (6,67, 9)	ID	ID	11	1
AGROPYRON DESERTORUM	12,24	2,36	236,11 (355,89, 9)	ID (0, 6)	9,93	31,11 (46,76, 9)	ID	ID	33	22
POA SP,	,17	,03	3,33 (10,00, 9)	ID (0, 6)	2,13	6,67 (20,00, 9)	ID	ID	11	2
CHENOPODIUM SP, '2G4	,00	,00	,00 (ID ,)	ID (0, 6)	,71	2,22 (6,67, 9)	ID	ID	11	1
SITANION LONGIFOLIOM	2,13	,41	41,11 (119,63, 9)	ID (0, 6)	1,06	3,33 (7,07, 9)	ID	ID	22	3
KOCHIA IRANICA	25,30	4,88	487,78 (996,54, 9)	655667 (*0160,, 6)	7,45	23,33 (43,59, 9)	32,78	140,50	33	33
CHENOPODIUM ALBUM	11,18	2,16	215,56 (436,09, 9)	203667 (316916, 6)	6,74	21,11 (41,97, 9)	10,18	48,24	22	18
DESCURAINIA PINNATA	,63	,12	12,22 (36,67, 9)	15000 (36742, 6)	2,13	6,67 (20,00, 9)	,75	11,25	11	3
PHLOX LONGIFOLIA	,00	,00	,00 (ID ,)	333 (816, 6)	,35	1,11 (3,33, 9)	,02	1,50	11	0
AGROPYRON TRACHYCAULUM	,52	,10	10,00 (17,32, 9)	ID (0, 6)	1,42	4,44 (7,26, 9)	ID	ID	33	2
EPILOBIUM ADENOCAULON	,29	,06	5,56 (16,67, 9)	ID (0, 6)	,71	2,22 (6,67, 9)	ID	ID	11	1
SALSOLA IBERICA	,00	,00	,00 (ID ,)	333 (816, 6)	,35	1,11 (3,33, 9)	,02	1,50	11	0
LEPIDIUM MONTANUM	,06	,01	1,11 (3,33, 9)	1667 (4082, 6)	,35	1,11 (3,33, 9)	,08	7,50	11	0
ORYZOPSIS HYMENOIDES	,00	,00	,00 (ID ,)	ID (0, 6)	,35	1,11 (3,33, 9)	ID	ID	11	0
POA SANDBERG	,23	,04	4,44 (13,33, 9)	ID (0, 6)	1,42	4,44 (13,33, 9)	ID	ID	11	2
ALL SPECIES		19,28	1928,33	1283667						

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS.
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA.
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- GREASEWOOD
SUMMARY-- 6 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
ARTEMISIA TRIDENTATA	24	31	31	86	10,40	90 (24, 6)	1040,50 (1056,49, 6)	2981 (4033, 6)	41,04 (9,22, 6)	100
ATRIPLEX CONFERTIFOLIA	0	1	9	11	,07	27 (41, 6)	7,33 (17,96, 6)	114 (240, 6)	7,33 (7,33, 6)	33
CHRYSOTHAMNUS NAUSEOSUS	8	18	16	43	3,71	47 (52, 6)	370,83 (555,78, 6)	1742 (2640, 6)	14,62 (6,83, 6)	50
CHRYSOTHAMNUS VISCIDIFLORUS	0	1	9	11	,14	27 (39, 6)	14,33 (35,11, 6)	111 (248, 6)	4,78 (4,78, 6)	50
SARCOBATUS VERMICULATUS	67	48	34	150	29,53	100 (0, 6)	2952,67 (824,47, 6)	4556 (2210, 6)	57,67 (5,51, 6)	100
ALL SPECIES					43,86		4385,67	9503		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

MATURE TREE STRATUM-- GREASEWOOD
SUMMARY-- 6 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*
NO TREE SPECIES				

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND (**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

HERBACEOUS STRATUM-- RABBITBRUSH
SUMMARY-- 7 HERB TRANSECTS WITHIN TYPE-- RABBITBRUSH

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA	STD DEV	N	**** DENSITY **** NO/HA	STD DEV	N	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN	ST,DEV	N	NUMBER /QUAD,	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
ELYMUS CINEREUS	74,33	23,83	2382,86	1542,12	7	ID	0	5	32,29	88,57	21,93	7	ID	ID	100	107
SISYMBRIUM SP,	,33	,11	10,71	28,35	7	ID	0	5	4,17	11,43	30,24	7	ID	ID	14	5
BROMUS TECTORUM	5,39	1,73	172,86	375,75	7	400	894	5	9,38	25,71	41,58	7	,02	,08	43	15
CHORISPORA TENELLA	,00	,00	,00	ID		ID	0	5	,52	1,43	3,78	7	ID	ID	14	1
ARTEMISIA LUDOVICIANA	,49	,16	15,71	21,49	7	2800	3899	5	3,13	8,57	12,15	7	,14	1,63	43	4
TARAXACUM OFFICINALE	,00	,00	,00	ID		400	894	5	1,56	4,29	5,35	7	,02	,47	43	2
COLLINSIA PARVIFLORA	,00	,00	,00	ID		ID	0	5	1,04	2,86	4,88	7	ID	ID	29	1
UIRB2 (MUSTARD)	,00	,00	,00	ID		ID	0	5	3,13	8,57	22,68	7	ID	ID	14	3
POA SP,	1,18	,38	37,86	100,16	7	ID	0	5	3,65	10,00	26,46	7	ID	ID	14	5
AGROPYRON SMITHII	3,25	1,04	104,29	148,87	7	ID	0	5	8,85	24,29	23,70	7	ID	ID	57	12
SCIRPUS ACUTUS	,07	,02	2,14	5,67	7	ID	0	5	1,56	4,29	11,34	7	ID	ID	14	2
POA PRATENSIS	4,43	1,42	142,14	292,46	7	ID	0	5	7,29	20,00	36,06	7	ID	ID	29	12
BROMUS SP,	1,25	,40	40,00	105,83	7	ID	0	5	1,04	2,86	7,56	7	ID	ID	14	2
PENSTEMON SP,	,00	,00	,00	ID		ID	0	5	,52	1,43	3,78	7	ID	ID	14	1
CHENOPODIUM FREMONTII	,31	,10	10,00	11,55	7	13600	10431	5	6,25	17,14	20,59	7	,68	3,97	57	7
DESCURAINIA PINNATA	,00	,00	,00	ID		1600	3578	5	,52	1,43	3,78	7	,08	5,60	14	1
JUNCUS ARCTICUS SSP, ATER	1,47	,47	47,14	81,80	7	ID	0	5	2,60	7,14	12,54	7	ID	ID	29	4
AGROPYRON REPENS	,89	,29	28,57	75,59	7	ID	0	5	,52	1,43	3,78	7	ID	ID	14	1
UIRB2 7/75	,09	,03	2,86	7,56	7	1600	3578	5	,52	1,43	3,78	7	,08	5,60	14	1
POA NEMORALIS VAR, INTERIOR	3,34	1,07	107,14	242,26	7	ID	0	5	6,25	17,14	37,29	7	ID	ID	29	10
DISTICHLIS STRICTA	1,07	,34	34,29	90,71	7	ID	0	5	2,08	5,71	15,12	7	ID	ID	14	3
ASTER CAMPESTRIS	,04	,01	1,43	3,78	7	800	1789	5	,52	1,43	3,78	7	,04	2,80	14	1
SITANION LONGIFOLIOM	,62	,20	20,00	52,92	7	ID	0	5	1,04	2,86	7,56	7	ID	ID	14	2
LEPIDIUM MONTANUM	,09	,03	2,86	7,56	7	1600	3578	5	1,04	2,86	7,56	7	,08	2,80	14	1
AGROPYRON TRACHYCAULUM	1,34	,43	42,86	113,39	7	ID	0	5	,52	1,43	3,78	7	ID	ID	14	2
ALL SPECIES		32,06	3205,71			22800										

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS,
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA,
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- RABBITBRUSH
SUMMARY-- 8 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN	SD	N	******* COVER ******** M2/HA	STD DEV	N	***** DENSITY **** NO/HA	ST DEV	N	MEAN INTERCEPT (CM) MEAN	STD ERR	N	CONSTANCY
GUTIERRIZIA SAROTHRAE	0	0	0	0	,00	0	0	8	,00	,00	8	0	0	8	,00	,00	8	0
ARTEMISIA TRIDENTATA	5	29	30	63	1,78	75	46	8	178,25	214,38	8	4025	9621	8	23,76	7,45	8	75
CHRYSOTHAMNUS NAUSEOSUS	37	42	31	109	14,47	77	38	8	1447,00	1681,18	8	5754	8304	8	30,44	7,52	8	88
CHRYSOTHAMNUS VISCIDIFLORUS	54	26	24	104	21,28	60	50	8	2127,62	2407,54	8	3637	4372	8	37,68	13,48	8	63
SARCOBATUS VERMICULATUS	5	3	14	22	1,95	35	45	8	195,25	338,20	8	419	614	8	14,30	7,03	8	50
SYMPHORICARPOS OREOPHILUS	0	0	1	1	,00	2	7	8	,00	,00	8	2	6	8	,00	,00	8	13
RIBES AUREUM	0	0	1	1	,00	2	7	8	,00	,00	8	2	6	8	,00	,00	8	13
					39,48				3948,12			13840						

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY,
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,

MATURE TREE STRATUM-- RABBITBRUSH
SUMMARY-- 8 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*
NO TREE SPECIES				

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND
(**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY,
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,

HERBACEOUS STRATUM-- BALD
SUMMARY-- 12 HERB TRANSECTS WITHIN TYPE-- BALD

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA	(STD DEV,	N)	**** DENSITY **** NO/HA	(STD DEV,	N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN	(ST,DEV,	N)	NUMBER /QUAD,	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
PHLOX MULTIFLORA	,71	,11	10,83	29,37	12	ID	0	5	,44	4,17	11,65	12	ID	ID	17	1
HAPLOPAPPUS ACAULIS	8,40	1,28	128,33	195,39	12	55600	51660	5	2,97	28,33	40,41	12	2,78	9,81	42	11
CASTILLEJA CHROMOSA	,11	,02	1,67	5,77	12	2000	4472	5	,52	5,00	11,68	12	,10	2,00	17	1
HAPLOPAPPUS NUTALLII	5,07	,77	77,50	75,84	12	76400	67549	5	6,04	57,50	28,00	12	3,82	6,64	92	11
PHLOX LONGIFOLIA	1,04	,16	15,83	23,14	12	38800	47405	5	4,29	40,83	33,43	12	1,94	4,75	75	5
KOELERIA GRACILIS	8,78	1,34	134,17	167,07	12	ID	0	5	5,25	50,00	39,54	12	ID	ID	75	14
POA SANDBERG	9,24	1,41	141,25	185,13	12	ID	0	5	5,69	54,17	37,77	12	ID	ID	75	15
ARENARIA SP,	,11	,02	1,67	5,77	12	ID	0	5	,52	5,00	17,32	12	ID	ID	8	1
JUNCUS SAXIMONTANUS	2,43	,37	37,08	31,73	12	4000	6928	5	2,97	28,33	27,58	12	,20	,71	75	5
CALOCHORTUS SP,	,00	,00	,00	ID		ID	0	5	,35	3,33	11,55	12	ID	ID	8	0
ASTRAGALUS SP,	,57	,09	8,75	15,83	12	ID	0	5	1,92	18,33	33,80	12	ID	ID	25	2
ZIGADENUS VENENOUS	,05	,01	,83	2,89	12	400	894	5	,26	2,50	4,52	12	,02	,80	25	0
LOMATIUM JUNIPERINUM	,00	,00	,00	ID		ID	0	5	,26	2,50	8,66	12	ID	ID	8	0
ANTENNARIA SP,	,33	,05	5,00	17,32	12	ID	0	5	,35	3,33	8,88	12	ID	ID	17	1
AGROPYRON SP,	3,52	,54	53,75	83,15	12	ID	0	5	4,02	38,33	47,64	12	ID	ID	42	8
U1B1	,08	,01	1,25	4,33	12	ID	0	5	,52	5,00	17,32	12	ID	ID	8	1
DELPHINIUM NELSONII	,00	,00	,00	ID		ID	0	5	,09	,83	2,89	12	ID	ID	8	0
STIPA SP,	,14	,02	2,08	5,82	12	ID	0	5	,35	3,33	7,78	12	ID	ID	17	0
CYMOPTERUS SP,	,03	,00	,42	1,44	12	ID	0	5	,96	9,17	26,10	12	ID	ID	17	1
U2B1	,00	,00	,00	ID		ID	0	5	,17	1,67	5,77	12	ID	ID	8	0
U3B1	,08	,01	1,25	4,33	12	ID	0	5	,09	,83	2,89	12	ID	ID	8	0
ERIOGONUM LONCHOPHYLLUM	2,89	,44	44,17	41,44	12	16000	8124	5	3,50	33,33	17,75	12	,80	2,40	92	6
PENSTEMON SP,	1,58	,24	24,17	49,21	12	ID	0	5	2,10	20,00	32,47	12	ID	ID	33	4
TRIFOLIUM GYMNOCARPUN	1,91	,29	29,17	31,39	12	11600	11866	5	2,80	26,67	21,88	12	,58	2,17	75	5
HEDYSARUM BOREALE	1,91	,29	29,17	66,40	12	1600	2608	5	1,40	13,33	18,75	12	,08	,60	50	3
PHYSARIA FLORIBUNDA	,25	,04	3,75	4,83	12	14000	12570	5	3,15	30,00	23,74	12	,70	2,33	83	3
U4B1	,05	,01	,83	2,89	12	ID	0	5	,09	,83	2,89	12	ID	ID	8	0
ERIGERON SP,	,00	,00	,00	ID		ID	0	5	,26	2,50	4,52	12	ID	ID	25	0
LUPINUS SP,	,05	,01	,83	2,89	12	ID	0	5	,09	,83	2,89	12	ID	ID	8	0
U1B2	,00	,00	,00	ID		ID	0	5	,09	,83	2,89	12	ID	ID	8	0
U2B2	,25	,04	3,75	12,99	12	ID	0	5	,61	5,83	20,21	12	ID	ID	8	1
U3B2	,05	,01	,83	2,89	12	ID	0	5	,17	1,67	5,77	12	ID	ID	8	0
POA SP,	,38	,06	5,83	13,79	12	ID	0	5	1,84	17,50	31,94	12	ID	ID	25	2
SOLIDAGO SP,	,00	,00	,00	ID		ID	0	5	,09	,83	2,89	12	ID	ID	8	0
LOMATIUM SP,	,22	,03	3,33	8,86	12	ID	0	5	1,75	16,67	30,25	12	ID	ID	33	2
SPHAERALCEA COCCINEA	,55	,08	8,33	22,90	12	8000	13638	5	,35	3,33	4,92	12	,40	12,00	33	1
U4B2	,05	,01	,83	2,89	12	ID	0	5	,09	,83	2,89	12	ID	ID	8	0
U5B2	,03	,00	,42	1,44	12	ID	0	5	,09	,83	2,89	12	ID	ID	8	0
ASTRAGALUS U1B3	,82	,13	12,50	43,30	12	ID	0	5	,70	6,67	23,09	12	ID	ID	8	2
U1B3	,44	,07	6,67	23,09	12	ID	0	5	,61	5,83	20,21	12	ID	ID	8	1
MENTZELIA MULTIFLORA	2,13	,32	32,50	40,93	12	11200	16346	5	3,32	31,67	34,33	12	,56	1,77	50	5
POA U1B3	,55	,08	8,33	28,87	12	ID	0	5	,44	4,17	14,43	12	ID	ID	8	1
ASTRAGALUS U2B3	,05	,01	,83	2,89	12	ID	0	5	,52	5,00	17,32	12	ID	ID	8	1
ARTEMISIA SP,	,11	,02	1,67	5,77	12	ID	0	5	,35	3,33	11,55	12	ID	ID	8	0
LYGODESMIA JUNCEA	,11	,02	1,67	3,89	12	2400	5367	5	,35	3,33	7,78	12	,12	3,60	17	0
LINUM LEWISII	,68	,10	10,42	18,40	12	3200	4382	5	,52	5,00	9,05	12	,16	3,20	33	1
CAREX SP,	,87	,13	13,33	43,13	12	ID	0	5	,26	2,50	6,22	12	ID	ID	17	1
POA U2B3	,05	,01	,83	2,89	12	ID	0	5	,09	,83	2,89	12	ID	ID	8	0
ASTRAGALUS U1B4	,85	,13	12,92	44,74	12	ID	0	5	,79	7,50	25,98	12	ID	ID	8	2
U1B4	,30	,05	4,58	15,88	12	ID	0	5	,61	5,83	20,21	12	ID	ID	8	1
CRYPTANTHA SERICEA	,00	,00	,00	ID		800	1095	5	,44	4,17	6,69	12	,04	,96	33	0
ERIOGONUM UMBELLATUM	,05	,01	,83	2,89	12	ID	0	5	,26	2,50	8,66	12	ID	ID	8	0
U1B5 (ATENN,)	,08	,01	1,25	4,33	12	ID	0	5	,79	7,50	25,98	12	ID	ID	8	1
KOCHIA SP,	,14	,02	2,08	7,22	12	ID	0	5	,52	5,00	17,32	12	ID	ID	8	1
SITANION LONGIFOLIUM	,00	,00	,00	ID		ID	0	5	,44	4,17	14,43	12	ID	ID	8	0
RORIPPA NASTURTIUM AQUATICUM	,03	,00	,42	1,44	12	ID	0	5	,17	1,67	5,77	12	ID	ID	8	0
AGROPYRON SMITHII	2,45	,38	37,50	85,29	12	ID	0	5	1,14	10,83	21,09	12	ID	ID	33	4
U2B5	,11	,02	1,67	5,77	12	ID	0	5	,17	1,67	5,77	12	ID	ID	8	0
ASTRAGALUS SPATULATUS	5,81	,89	88,75	125,52	12	92800	30874	5	4,02	38,33	40,19	12	4,64	12,10	58	10
STIPA COMATA	2,62	,40	40,00	94,10	12	ID	0	5	1,49	14,17	29,06	12	ID	ID	25	4
HYMENOXYS ACAULIS	3,76	,57	57,50	79,21	12	69200	48241	5	3,50	33,33	35,25	12	3,46	10,38	50	7
PENSTEMON CAESPITOSUS	6,27	,96	95,83	134,47	12	71200	64352	5	4,46	42,50	42,88	12	3,56	8,38	58	11
ASTRAGALUS CHAMAELEUCE	,57	,09	8,75	13,84	12	6000	7348	5	1,92	18,33	27,25	12	,30	1,64	42	2
ANDROSACE SEPTENTRIONALIS	,00	,00	,00	ID		400	894	5	,44	4,17	11,65	12	,02	,48	17	0
COMANDRA UMBELLATA	,87	,13	13,33	31,43	12	7200	7014	5	,61	5,83	9,00	12	,36	6,17	42	1
AGROPYRON TRACHYCAULUM	8,56	1,31	130,83	148,17	12	ID	0	5	4,64	44,17	47,19	12	ID	ID	50	13
OXYTROPIS LAMBERTII	,65	,10	10,00	28,60	12	800	1095	5	,52	5,00	11,68	12	,04	,80	25	1
LYGADESMIA SP,	,05	,01	,83	2,89	12	ID	0	5	,44	4,17	9,96	12	ID	ID	17	0
EUPHORBIA ROBUSTA	,00	,00	,00	ID		ID	0	5	,17	1,67	3,89	12	ID	ID	17	0
CASTILLEJA LINARIAEFOLIA	,22	,03	3,33	11,55	12	ID	0	5	,17	1,67	5,77	12	ID	ID	8	0
ACHILLEA LANULOSA	,00	,00	,00	ID		ID	0	5	,09	,83	2,89	12	ID	ID	8	0
POA FENDLERIANA	,44	,07	6,67	23,09	12	ID	0	5	,17	1,67	5,77	12	ID	ID	8	1
HYMENOPAPPUS FILIFOLIUS	4,03	,62	61,67	213,62	12	ID	0	5	,87	8,33	28,87	12	ID	ID	8	5
STREPTANTHUS CORDATUS	,03	,00	,42	1,44	12	ID	0	5	,26	2,50	8,66	12	ID	ID	8	0
ERIOGONUM ALATUM	,49	,07	7,50	25,98	12	ID	0	5	,44	4,17	14,43	12	ID	ID	8	1
ORYZOPSIS HYMENOIDES	,16	,02	2,50	6,22	12	ID	0	5	,44	4,17	9,96	12	ID	ID	17	1
DISTICHLIS STRICTA	,00	,00	,00	ID		ID	0	5	,09	,83	2,89	12	ID	ID	8	0
OENOTHERA LAEVANDUFOLIA	,16	,02	2,50	8,66	12	ID	0	5	,17	1,67	5,77	12	ID	ID	8	0
BROMUS TECTORUM	,05	,01	,83	2,89	12	ID	0	5	,09	,83	2,89	12	ID	ID	8	0
LEPTODACTYLON PUNGENS	,33	,05	5,00	14,46	12	800	1789	5	,26	2,50	6,22	12	,04	1,60	17	1
PHLOX HOODII	,87	,13	13,33	31,43	12	15200	21005	5	,70	6,67	16,14	12	,76	11,40	17	2
ERIGERON EATONII	,11	,02	1,67	5,77	12	3200	7155	5	,26	2,50	8,66	12	,16	6,40	8	0
ARENARIA EASTWOODIAE	,71	,11	10,83	25,39	12	21200	29107	5	1,49	14,17	33,15	12	1,06	7,48	17	2
LYGODESMIA JUNCEA	,11	,02	1,67	5,77	12	3200	7155	5	,17	1,67	5,77	12	,16	9,60	8	0
LUPINUS CAUDATUS	,00	,00	,00	ID		400	894	5	,09	,83	2,89	12	,02	2,40	8	0
IPOMOPSIS AGGREGATA	,55	,08	8,33	19,92	12	12800	13312	5	,70	6,67	11,55	12	,64	9,60	33	1
EPILOBIUM ADENOCAULON	,49	,07	7,50	25,98	12	ID	0	5	,26	2,50	6,22	12	ID	ID	17	1
ASTRAGALUS PURSHII	,16	,02	2,50	8,66	12	8000	10198	5	1,14	10,83	21,51	12	,40	3,69	25	1
ARTEMISIA DRACUNCULUS	1,09	,17	16,67	38,92	12	6400	8877	5	,61	5,83	13,79	12	,32	5,49	17	2
ERIGERON PUMILIS	,16	,02	2,50	4,52	12	1600	1673	5	,26	2,50	4,52	12	,08	3,20	25	0
ALL SPECIES		15,28	1528,33			566400										

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPEC AND ALL TRANSECTS,
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA,
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM DATA,
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUEN

SHRUB-SEEDLING STRATUM-- BALD
SUMMARY-- 11 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
JUNIPERUS OSTEOSPERMA	0	0	1	1	,00	2 (6, 11)	,00 (,00, 11)	2 (5, 11)	,00 (,00, 11)	9
PINUS EDULIS	3	0	4	7	,08	9 (19, 11)	7,64 (22,50, 11)	12 (24, 11)	7,64 (6,79, 11)	27
MAHONIA REPENS	1	1	3	4	,02	5 (18, 11)	1,64 (5,43, 11)	64 (211, 11)	,82 (,82, 11)	9
GUTIERRIZIA SAROTHRAE	23	23	8	53	,64	16 (37, 11)	64,18 (180,53, 11)	1906 (5258, 11)	2,08 (1,42, 11)	18
ARTEMISIA FRIGIDA	32	64	13	109	,89	27 (47, 11)	88,73 (183,07, 11)	5365 (11425, 11)	3,69 (2,29, 11)	27
ARTEMISIA TRIDENTATA	9	1	14	23	,24	29 (31, 11)	24,09 (36,60, 11)	55 (61, 11)	21,09 (10,28, 11)	64
CERCOCARPUS MONTANUS	4	0	3	7	,12	5 (18, 11)	11,73 (38,89, 11)	21 (70, 11)	11,73 (11,73, 11)	9
CHRYSOTHAMNUS VISCIDIFLORUS	2	4	11	17	,06	24 (40, 11)	6,18 (13,78, 11)	300 (628, 11)	2,27 (1,60, 11)	36
EUROTIA LANATA	0	0	2	2	,00	4 (8, 11)	,00 (,00, 11)	5 (11, 11)	,00 (,00, 11)	18
PURSHIA TRIDENTATA	2	0	1	2	,04	2 (6, 11)	4,36 (14,47, 11)	2 (5, 11)	4,36 (4,36, 11)	9
TETRADYMIA CANESCENS	4	4	22	30	,10	47 (38, 11)	10,45 (19,45, 11)	358 (574, 11)	5,14 (2,45, 11)	73
AMELANCHIER UTAHENSIS	17	0	6	23	,47	13 (18, 11)	46,64 (97,00, 11)	41 (72, 11)	33,47 (27,97, 11)	36
SYMPHORICARPOS OREOPHILUS	3	1	6	9	,07	13 (26, 11)	7,09 (23,52, 11)	55 (118, 11)	1,77 (1,77, 11)	27
CHRYSOTHAMNUS DEPRESSUS	3	2	8	13	,08	18 (32, 11)	7,64 (23,72, 11)	167 (325, 11)	1,89 (1,46, 11)	27
ALL SPECIES					2,80		280,36	8350		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

MATURE TREE STRATUM-- BALD
SUMMARY-- 11 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)
PINUS EDULIS	0	100	100	200	,00	4 (12, 11)	,00 (,00, 11)	5 (15, 11)
ALL SPECIES					,00		,00	5

SPECIES	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	***** BASAL AREA ***** RELATIVE	M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
PINUS EDULIS	,00 (,00, 11)	100	1,04 (3,46, 11)	300	9
ALL SPECIES			1,04		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND
(**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

HERBACEOUS STRATUM-- SHADSCALE
SUMMARY-- 6 HERB TRANSECTS WITHIN TYPE-- SHADSCALE

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA (STD DEV, N)	**** DENSITY **** NO/HA (STD DEV,N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN (ST,DEV, N)	NUMBER /QUAD,	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
RORIPPA NASTURTIUM AQUATICUM	1,35	,02	2,50 (6,12, 6)	ID (0, 4)	5,56	8,33 (20,41, 6)	ID	ID	17	7
ERIOGONUM UMBELLATUM	4,95	,09	9,17 (22,45, 6)	ID (0, 4)	7,78	11,67 (28,58, 6)	ID	ID	17	13
OENOTHERA SP,	,00	,00	,00 (ID ,)	ID (0, 4)	3,33	5,00 (12,25, 6)	ID	ID	17	3
ORYZOPSIS HYMENOIDES	11,26	,21	20,83 (17,44, 6)	ID (0, 4)	14,44	21,67 (7,53, 6)	ID	ID	100	26
PHLOX LONGIFOLIA	,90	,02	1,67 (4,08, 6)	ID (0, 4)	2,22	3,33 (8,16, 6)	ID	ID	17	3
LYGODESMIA JUNCEA	,90	,02	1,67 (4,08, 6)	ID (0, 4)	2,22	3,33 (8,16, 6)	ID	ID	17	3
SITANION LONGIFOLIUM	4,95	,09	9,17 (10,21, 6)	ID (0, 4)	4,44	6,67 (5,16, 6)	ID	ID	67	9
MENTZELIA MULTIFLORA	1,80	,03	3,33 (6,06, 6)	ID (0, 4)	4,44	6,67 (12,11, 6)	ID	ID	33	6
CHENOPODIUM FREMONTII	4,50	,08	8,33 (16,02, 6)	14500 (21749, 4)	11,11	16,67 (20,66, 6)	,72	4,35	50	16
HAPLOPAPPUS NUTALLII	16,22	,30	30,00 (48,17, 6)	6000 (7118, 4)	8,89	13,33 (20,66, 6)	,30	2,25	33	25
ERIOGONUM LONCHOPHYLLUM	41,44	,77	76,67 (118,94, 6)	50500 (59585, 4)	17,78	26,67 (41,31, 6)	2,52	9,47	33	59
OENTHERA CAESPITOSA	3,60	,07	6,67 (10,33, 6)	3500 (4123, 4)	7,78	11,67 (18,35, 6)	,17	1,50	33	11
ARENARIA EASTWOODIAE	,00	,00	,00 (ID ,)	500 (1000, 4)	1,11	1,67 (4,08, 6)	,02	1,50	17	1
SPHAERALCEA COCCINEA	6,31	,12	11,67 (18,35, 6)	15000 (17397, 4)	5,56	8,33 (13,29, 6)	,75	9,00	33	12
CRYPTANTHA SERICEA	,00	,00	,00 (ID ,)	500 (1000, 4)	1,11	1,67 (4,08, 6)	,02	1,50	17	1
CHENOPODIUM LEPTOPHYLLUM	1,80	,03	3,33 (8,16, 6)	4000 (8000, 4)	2,22	3,33 (8,16, 6)	,20	6,00	17	4
ALL SPECIES		1,85	185,00	94500						

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS,
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA,
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- SHADSCALE
SUMMARY-- 5 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
PINUS EDULIS	3	0	4	7	,45	16 (22, 5)	45,00 (100,62, 5)	20 (30, 5)	22,50 (22,50, 5)	40
GUTIERRIZIA SAROTHRAE	0	0	1	1	,00	4 (9, 5)	,00 (,00, 5)	10 (22, 5)	,00 (,00, 5)	20
ARTEMISIA FRIGIDA	2	5	5	11	,25	20 (45, 5)	25,40 (56,80, 5)	263 (589, 5)	3,63 (3,63, 5)	20
ARTEMISIA TRIDENTATA	55	23	19	97	7,49	80 (28, 5)	749,20 (834,86, 5)	1317 (995, 5)	47,34 (13,31, 5)	100
ATRIPLEX CANESCENS	2	5	6	12	,25	24 (36, 5)	25,00 (55,90, 5)	263 (477, 5)	6,25 (6,25, 5)	40
ATRIPLEX CONFERTIFOLIA	29	42	22	93	3,92	96 (9, 5)	391,60 (233,84, 5)	2343 (1172, 5)	30,18 (3,46, 5)	100
CHRYSOTHAMNUS NAUSEOSUS	2	4	13	19	,22	56 (46, 5)	21,80 (29,95, 5)	250 (235, 5)	10,90 (6,70, 5)	80
CHRYSOTHAMNUS VISCIDIFLORUS	3	10	12	25	,39	52 (36, 5)	38,60 (86,31, 5)	537 (619, 5)	4,82 (4,82, 5)	100
EPHEDRA VIRIDIS	0	0	1	1	,00	4 (9, 5)	,00 (,00, 5)	3 (7, 5)	,00 (,00, 5)	20
EUROTIA LANATA	0	1	3	4	,05	12 (27, 5)	4,60 (10,29, 5)	70 (157, 5)	2,30 (2,30, 5)	20
SARCOBATUS VERMICULATUS	2	3	7	12	,29	32 (39, 5)	28,80 (58,97, 5)	157 (157, 5)	15,40 (13,04, 5)	80
TETRADYMIA CANESCENS	3	6	7	16	,42	28 (30, 5)	42,20 (88,34, 5)	363 (683, 5)	40,73 (39,82, 5)	80
SYMPHORICARPOS OREOPHILUS	0	0	1	1	,00	4 (9, 5)	,00 (,00, 5)	7 (15, 5)	,00 (,00, 5)	20
					13,72		1372,20	5603		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY,
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,

MATURE TREE STRATUM-- SHADSCALE
SUMMARY-- 5 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	*** RELATIVE *** COVER	DENSITY	FREQ	IMPORTANCE VALUE*	PER CENT COVER	* FREQUENCY ** MEAN (SD, N)	******* COVER ******** M2/HA (STD DEV, N)	***** DENSITY **** NO/HA (ST DEV, N)
JUNIPERUS OSTEOSPERMA	100	100	100	300	,87	8 (18, 5)	86,80 (194,09, 5)	10 (22, 5)
ALL SPECIES					,87		86,80	10

SPECIES	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	***** BASAL AREA ***** RELATIVE	M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
JUNIPERUS OSTEOSPERMA	86,80 (86,80, 5)	100	,69 (1,53, 5)	300	20
ALL SPECIES			,69		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND
(**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY,
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA,

HERBACEOUS STRATUM-- RIPARIAN
SUMMARY-- 12 HERB TRANSECTS WITHIN TYPE-- RIPARIAN

SPECIES	RELATIVE COVER	PERCENT COVER	****** COVER ******* M2/HA	(STD DEV, N)	** DENSITY **** NO/HA	(STD DEV,N)	RELATIVE FREQUENCY	PER CENT FREQUENCY MEAN	(ST.DEV, N)	NUMBER /QUAD.	SOCIABILITY	CONSTANCY	IMPORTANCE VALUE
BROMUS INERMIS	20,25	12,48	1247,92	(2223,43, 12)	ID	(0, 6)	7,75	25,00	(41,89, 12)	ID	ID	33	28
U1R1	1,47	,90	90,42	(313,21, 12)	ID	(0, 6)	1,29	4,17	(14,43, 12)	ID	ID	8	3
BROMUS SP.	,04	,02	2,50	(8,66, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
TARAXACUM SP.	,37	,22	22,50	(54,63, 12)	ID	(0, 6)	2,58	8,33	(16,42, 12)	ID	ID	25	3
ERIGERON EATONII	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
JUNCUS SP.	,22	,13	13,33	(30,85, 12)	ID	(0, 6)	,78	2,50	(4,52, 12)	ID	ID	25	1
CHENOPODIUM FREMONTII	,07	,04	4,17	(6,69, 12)	7000	(10863, 6)	3,88	12,50	(17,65, 12)	,35	2,80	42	4
DESCURAINIA SP.	,16	,10	10,00	(34,64, 12)	ID	(0, 6)	2,33	7,50	(20,50, 12)	ID	ID	17	2
CAREX SP.	1,55	,96	95,83	(193,60, 12)	ID	(0, 6)	1,29	4,17	(7,93, 12)	ID	ID	25	3
ARABIS SP.	,01	,01	,83	(2,89, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
POA PRATENSIS	6,81	4,20	420,00	(840,06, 12)	ID	(0, 6)	10,34	33,33	(33,67, 12)	ID	ID	75	17
U1R2 (35)	,01	,01	,83	(2,89, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
U1R3 (46)	,27	,17	16,67	(57,74, 12)	ID	(0, 6)	,52	1,67	(5,77, 12)	ID	ID	8	1
LACTUCA SP.	,07	,04	4,17	(14,43, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
U2R3	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
RANUNCULUS SP.	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
SCROPHULARIA LANCEOLATA	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
ACHILLEA LANULOSA	,22	,13	13,33	(28,39, 12)	ID	(0, 6)	1,81	5,83	(10,84, 12)	ID	ID	25	2
TARAXACUM OFFICINALE	1,27	,78	78,33	(144,34, 12)	22333	(17270, 6)	8,53	27,50	(23,79, 12)	1,12	4,06	75	10
DESCURAINIA PINNATA	,34	,21	20,83	(42,95, 12)	27333	(56294, 6)	3,10	10,00	(15,95, 12)	1,37	13,67	42	3
BROMUS TECTORUM	,11	,07	6,67	(23,09, 12)	ID	(0, 6)	1,29	4,17	(14,43, 12)	ID	ID	8	1
ELYMUS CINEREUS	18,98	11,70	1170,00	(2146,85, 12)	ID	(0, 6)	6,46	20,83	(36,05, 12)	ID	ID	33	25
ARTEMISIA LUDOVICIANA	,61	,38	37,50	(129,90, 12)	ID	(0, 6)	2,33	7,50	(25,98, 12)	ID	ID	8	3
ARTEMISIA DRACUNCULUS	,12	,07	7,50	(25,98, 12)	ID	(0, 6)	,52	1,67	(5,77, 12)	ID	ID	8	1
MENTZELIA MULTIFLORA	,00	,00	,00	(ID ,)	ID	(0, 6)	,52	1,67	(5,77, 12)	ID	ID	8	1
CHAENACTIS DOUGLASII	,04	,02	2,50	(8,66, 12)	ID	(0, 6)	,78	2,50	(8,66, 12)	ID	ID	8	1
PHYSARIA FLORIBUNDA	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
ZIGADENUS VENENOSUS	,14	,08	8,33	(28,87, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
PLANTAGO MAJOR	,05	,03	3,33	(8,88, 12)	667	(1633, 6)	,52	1,67	(3,89, 12)	,03	2,00	17	1
AGROPYRON TRACHYCAULUM	,16	,10	10,00	(23,74, 12)	ID	(0, 6)	1,29	4,17	(11,65, 12)	ID	ID	17	1
JUNCUS SAXIMONTANUS	,01	,01	,83	(2,89, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
RANUNCULUS CYMBALARIA	1,00	,62	61,67	(101,70, 12)	49667	(109152, 6)	2,58	8,33	(10,30, 12)	2,48	29,80	50	4
U1R6 7/75	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
GERANIUM RICHARDSONII	,03	,02	1,67	(5,77, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
AVENAE ? R6 7/75	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
SENECIO SPARTIOIDES	1,19	,73	73,33	(184,70, 12)	75000	(183712, 6)	1,55	5,00	(10,00, 12)	3,75	75,00	25	3
SOLIDAGO SP.	,14	,08	8,33	(28,87, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
U2R6 7/75	,07	,04	4,17	(14,43, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
SMILACINA STELLATA	,41	,25	25,00	(86,60, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	1
CIRSIUM SP.	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
JUNCUS SP. '1 R7 7/75	,01	,01	,83	(2,89, 12)	ID	(0, 6)	,52	1,67	(5,77, 12)	ID	ID	8	1
AGROPYRON SP. '1 R7 7/75	,05	,03	3,33	(11,55, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
GRASS'1 R7 7/75	,03	,02	1,67	(5,77, 12)	ID	(0, 6)	,52	1,67	(5,77, 12)	ID	ID	8	1
U1R7 7/75	,00	,00	,00	(ID ,)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
AGROPYRON SP. '2 R7 7/75	,05	,03	3,33	(11,55, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
AGROPYRON SPICATUM	,03	,02	1,67	(5,77, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
GALIUM BOREALE	,01	,01	,83	(2,89, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
U1R1 7/75	1,03	,63	63,33	(219,39, 12)	187333	(458871, 6)	1,29	4,17	(14,43, 12)	9,37	224,80	8	2
AGROPYRON REPENS	19,70	12,14	1214,17	(2552,94, 12)	ID	(0, 6)	5,94	19,17	(36,05, 12)	ID	ID	25	26
JUNCUS ARCTICUS SSP. ATER	1,93	1,19	119,17	(317,62, 12)	ID	(0, 6)	1,55	5,00	(7,98, 12)	ID	ID	33	3
SPOROBOLUS AIROIDES	,08	,05	5,00	(14,46, 12)	333	(816, 6)	,78	2,50	(4,52, 12)	,02	,67	25	1
CARYY NEBRASKENSIS	,49	,30	30,00	(100,81, 12)	ID	(0, 6)	,52	1,67	(3,89, 12)	ID	ID	17	1
CARYX SP. '2 R1(8) 7/75	,68	,42	41,67	(144,34, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	1
AGROPYRON SP.	2,57	1,58	158,33	(548,48, 12)	ID	(0, 6)	,78	2,50	(8,66, 12)	ID	ID	8	3
KOCHIA IRANICA	,41	,25	25,00	(58,54, 12)	77333	(119911, 6)	,78	2,50	(6,22, 12)	3,87	154,67	17	1
	,01	,01	,83	(2,89, 12)	1333	(3266, 6)	,52	1,67	(5,77, 12)	,07	4,00	8	1
AGROPYRON SMITHII	10,17	6,27	626,67	(1824,42, 12)	ID	(0, 6)	4,65	15,00	(30,60, 12)	ID	ID	33	15
CHENOPODIUM ALBUM	,38	,23	23,33	(39,62, 12)	6000	(7043, 6)	1,81	5,83	(9,96, 12)	,30	5,14	33	2
LACTUCA SERRIOLA	,04	,02	2,50	(6,22, 12)	1333	(2422, 6)	,52	1,67	(3,89, 12)	,07	4,00	17	1
U2R2 7/75	,14	,08	8,33	(28,87, 12)	6667	(16330, 6)	,26	,83	(2,89, 12)	,33	40,00	8	0
HORDEUM JUBATUM	,31	,19	19,17	(47,19, 12)	ID	(0, 6)	,52	1,67	(3,89, 12)	ID	ID	17	1
CAREX VERNACULA	,14	,08	8,33	(28,87, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
AGROPYRON SP. '2 R3(10) 7/75	,30	,18	18,33	(63,51, 12)	ID	(0, 6)	,78	2,50	(8,66, 12)	ID	ID	8	1
CHENOPODIUM LEPTOPHYLLUM	,05	,03	3,33	(11,55, 12)	1000	(2449, 6)	,26	,83	(2,89, 12)	,05	6,00	8	0
U1R3 7/75	,03	,02	1,67	(5,77, 12)	333	(816, 6)	,26	,83	(2,89, 12)	,02	2,00	8	0
MENTHA ARVENSE	,05	,03	3,33	(11,55, 12)	5333	(13064, 6)	,26	,83	(2,89, 12)	,27	32,00	8	0
ERIGERON SPECIOSUS	2,04	1,26	125,83	(378,14, 12)	268000	(623405, 6)	2,84	9,17	(21,09, 12)	13,40	146,18	25	5
SOLIDAGO MULTIRADIATA VAR. S	,27	,17	16,67	(51,76, 12)	34000	(77553, 6)	,52	1,67	(3,89, 12)	1,70	102,00	17	1
TRIGLOCHIN MARITIMA	,03	,02	1,67	(5,77, 12)	667	(1633, 6)	,26	,83	(2,89, 12)	,03	4,00	8	0
ELEOCHARIS MACROSTACHYA	,14	,08	8,33	(28,87, 12)	ID	(0, 6)	,26	,83	(2,89, 12)	ID	ID	8	0
CAREX LANUGINOSA	,68	,42	41,67	(95,04, 12)	ID	(0, 6)	1,03	3,33	(6,51, 12)	ID	ID	25	2
CHENOPODIUM HYBRIDUM	,23	,14	14,17	(36,30, 12)	4333	(8802, 6)	1,55	5,00	(12,43, 12)	,22	4,33	17	2
POA NEMORALIS VAR. INTERIOR	,77	,47	47,50	(164,54, 12)	ID	(0, 6)	1,29	4,17	(14,43, 12)	ID	ID	8	2
LEPIDIUM MONTANUM	,01	,01	,83	(2,89, 12)	333	(816, 6)	,26	,83	(2,89, 12)	,02	2,00	8	0
SITANION LONGIFOLIUM	,19	,12	11,67	(30,10, 12)	ID	(0, 6)	,52	1,67	(3,89, 12)	ID	ID	17	1
HORDEUM BRACHYANTHERUM	,78	,48	48,33	(167,43, 12)	ID	(0, 6)	,52	1,67	(5,77, 12)	ID	ID	8	1
ALL SPECIES		61,63	6163,33		776333								

NOTES: 1) ID= INSUFFICIENT DATA, DENSITY DATA NOT COLLECTED FOR ALL SPECIES AND ALL TRANSECTS.
2) SOCIABILITY IS DEPENDENT UPON DENSITY DATA.
3) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.
4) IMPORTANCE VALUE EQUALS RELATIVE COVER PLUS RELATIVE FREQUENCY

SHRUB-SEEDLING STRATUM-- RIPARIAN
SUMMARY-- 9 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	RELATIVE COVER	RELATIVE DENSITY	RELATIVE FREQ	IMPORTANCE VALUE*	PER CENT COVER	FREQUENCY MEAN (SD, N)	COVER M2/HA (STD DEV, N)	DENSITY NO/HA (ST DEV, N)	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	CONSTANCY
POPULUS TREMULOIDES	11	3	3	17	3,34	11 (33, 9)	334,11 (1002,33, 9)	198 (594, 9)	12,85 (12,85, 9)	11
PSEUDOTSUGA MENZIESII (T)	11	9	3	22	3,18	11 (33, 9)	318,33 (955,00, 9)	546 (1639, 9)	9,95 (9,95, 9)	11
GUTIERRIZIA SAROTHRAE	0	0	1	1	,01	2 (7, 9)	1,22 (3,67, 9)	4 (11, 9)	1,22 (1,22, 9)	11
ARTEMISIA TRIDENTATA	16	21	13	51	4,91	58 (47, 9)	491,33 (951,18, 9)	1313 (1916, 9)	24,44 (10,31, 9)	67
ATRIPLEX CONFERTIFOLIA	0	0	1	1	,00	2 (7, 9)	,00 (,00, 9)	6 (17, 9)	,00 (,00, 9)	11
CHRYSOTHAMNUS NAUSEOSUS	11	11	17	39	3,32	73 (39, 9)	331,78 (432,71, 9)	678 (593, 9)	40,70 (8,84, 9)	89
CHRYSOTHAMNUS VISCIDIFLORUS	0	0	1	1	,06	2 (7, 9)	6,11 (18,33, 9)	2 (6, 9)	6,11 (6,11, 9)	11
PRUNUS VIRGINIANA	3	3	3	9	,91	13 (22, 9)	91,22 (165,49, 9)	185 (453, 9)	20,84 (10,50, 9)	33
PACHYSTIMA MYRSINITES	0	0	1	1	,00	2 (7, 9)	,00 (,00, 9)	9 (28, 9)	,00 (,00, 9)	11
ROSA SP.	0	0	1	1	,00	2 (7, 9)	,00 (,00, 9)	9 (28, 9)	,00 (,00, 9)	11
SARCOBATUS VERMICULATUS	0	0	1	1	,00	4 (13, 9)	,00 (,00, 9)	20 (61, 9)	,00 (,00, 9)	11
SALIX EXIGUA	2	0	1	3	,51	2 (7, 9)	50,78 (152,33, 9)	19 (56, 9)	12,69 (12,69, 9)	11
AMELANCHIER UTAHENSIS	2	2	6	10	,61	27 (33, 9)	60,67 (119,26, 9)	135 (226, 9)	12,20 (6,97, 9)	56
SYMPHORICARPOS OREOPHILUS	10	19	13	42	3,09	58 (46, 9)	308,78 (368,16, 9)	1154 (1742, 9)	45,49 (19,42, 9)	67
AMELANCHIER ALNIFOLIA	0	0	0	0	,00	0 (0, 9)	,00 (,00, 9)	0 (0, 9)	,00 (,00, 9)	0
RIBES AUREUM	7	4	11	21	1,98	47 (42, 9)	197,56 (283,25, 9)	233 (284, 9)	47,89 (22,65, 9)	67
ROSA WOODSII	10	16	12	37	2,84	51 (49, 9)	284,22 (319,22, 9)	956 (1308, 9)	27,89 (11,21, 9)	56
RIBES CEREUM	1	1	4	6	,35	16 (28, 9)	34,67 (89,98, 9)	52 (100, 9)	19,56 (15,21, 9)	33
RIBES INERME	2	2	6	10	,64	27 (33, 9)	64,22 (152,91, 9)	128 (200, 9)	8,70 (6,72, 9)	44
SALIX INTERIOR	7	7	4	19	2,20	18 (37, 9)	220,00 (556,73, 9)	444 (1213, 9)	14,53 (9,74, 9)	22
BETULA FONTINALIS	6	0	3	9	1,74	11 (33, 9)	173,78 (521,33, 9)	24 (72, 9)	34,76 (34,76, 9)	11
SWIDA SERICEA	0	0	1	2	,15	4 (13, 9)	14,78 (44,33, 9)	4 (11, 9)	7,39 (7,39, 9)	11
ALL SPECIES					29,84		2983,56	6119		

NOTES: 1) IMPORTANCE VALUE = RELATIVE COVER + RELATIVE DENSITY + RELATIVE FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.

MATURE TREE STRATUM-- RIPARIAN
SUMMARY-- 9 NON-PERM, TRANSECT(S)/TYPE 1975

SPECIES	RELATIVE COVER	RELATIVE DENSITY	RELATIVE FREQ	IMPORTANCE VALUE*	PER CENT COVER	FREQUENCY MEAN (SD, N)	COVER M2/HA (STD DEV, N)	DENSITY NO/HA (ST DEV, N)
POPULUS TREMULOIDES	100	100	100	300	2,47	4 (13, 9)	246,89 (740,67, 9)	6 (17, 9)
ALL SPECIES					2,47		246,89	6

SPECIES	MEAN INTERCEPT (CM) MEAN (STD ERR, N)	BASAL AREA RELATIVE	BASAL AREA M2/HA (STD DEV, N)	IMP VAL**	CONSTANCY
POPULUS TREMULOIDES	18,99 (18,99, 9)	100	,12 (,37, 9)	300	11
ALL SPECIES			,12		

NOTES: 1) IMPORTANCE VALUE IS PRESENTED AS (*)THE SUM OF RELATIVE COVER, DENSITY AND FREQUENCY, AND (**)THE SUM OF RELATIVE BASAL AREA, DENSITY AND FREQUENCY.
2) STANDARD DEVIATION FOR PER CENT COVER CAN BE CALCULATED FROM COVER DATA.